DOCUMENT RESUME

ED 167 801 SE 026 787

AUTHOR	Brown, Evelyn; And Others
TITLE	Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: Mathematics in Energy, Grades 8-9.
INSTITUTION	National Science Teachers Association, Washington, D.C.
SPONS AGENCY	Department of Energy, Washington, D.C.
REPORT NO	HCP/U-3841-02
PUB DATE	Nov 78
CONTRACT	EX-76-C-10-3841
NOTE	105p.; Not available in hard copy due to marginal legibility of original document
AVAILABLE FROM	U.S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830 (no price quoted)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Curriculum Enrichment; Decimal Fractions; *Energy; Fractions; *Junior High Schools; *Mathematical Applications; *Mathematics Education; Percentage; Problem Solving; Ratios (Mathematics)
IDENTIFIERS	*Energy Education; National Science Teachers Association; *Project for an Energy-Enriched Curriculum

ABSTRACT

This publication is part of a series of instructional units produced by NSTA's Project for an Energy-Enriched Curriculum. The teacher's manual and the student guide for a mathematics unit in this series are presented here. This unit attempts to teach students some necessary mathematical skills needed to understand quantitative facts about energy. A pre/post test is given in the teacher's manual. Five activities are given along with problems in: (1) fractions; (2) decimals; (3) percents; (4) graphing; and (5) energy applications. (MR)

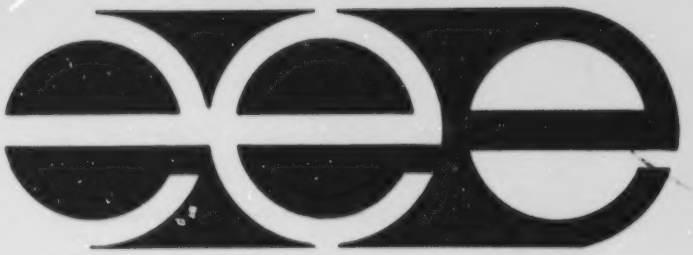
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

no ED for this one SE

HCP/U3841-02

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY



ED167401

Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy

Mathematics in Energy

Grades 8-9

Reprinted by:
U.S. Department of Energy

November 1978

National Science Teachers Association

Prepared for
U.S. Department of Energy
Office of Education, Business and Labor Affairs
Under Contract No. EX-76C-10-3841

SE 026 787

This material was produced by the National Science Teachers Association under contract with the U.S. Department of Energy. The facts, statistics, and conclusions are those of the authors.

Copies of these materials may be obtained from:

U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

This instructional unit was produced by NSTA's Project for an Energy-Enriched Curriculum under contract #EX-76-C-10-3841 from the Education Programs Branch, Office of Public Affairs, the U.S. Energy Research and Development Administration (now U.S. Department of Energy). The NSTA project staff is as follows:

John M. Fowler, Project Director
King C. Kryger, Associate Project Director
Helen H. Carey, Editor-Coordinator
Helenmarie Hofman, Science Curriculum Specialist
Elizabeth Larkin, Social Studies Curriculum Specialist
Mary T. McGuire, Associate Editor

"Mathematics in Energy" is the product of a writing session at the University of Maryland during Summer 1977. The following teachers were the main contributors to this unit:

Evelyn Brown
Herndon Intermediate School
Fairfax County, Virginia

Lois Lutes
Herndon Intermediate School
Fairfax County, Virginia

Charles Durr
Syracuse Public Schools
Syracuse, New York

Artist: Jessica Morgan

October 1978
John M. Fowler
Project Director

Mathematics in Energy

Introduction

Mathematics is the language we use to describe the quantitative aspects of our daily lives. Without it we cannot describe what we really mean by "big" and "small," "heavy," and "light," "tall" and "short."

We also need it to understand growth rates of increase, speed, etc. Since much of what we need to know about energy needs numbers to interpret it, this "Energy in Mathematics" unit is most appropriate. We hope that students will learn some important mathematical skills by working through these problems and at the same time will learn some important quantitative facts about energy.

Activity	Contents
1	Fractions Students review fractions and apply fraction skills.
2	Decimals A review of decimals and an application of decimal skills.
3	Percents Students review percent and apply percent skills.
4	Graphing-It Students learn to interpret and construct a variety of graphs, using energy-related materials.
5	Energy Activities Energy math problems for students.
	Facts About Energy Energy facts for easy reference.

Teacher Manual

Mathematics in Energy

Overview

We are dependent upon mathematics for interpretations in our daily lives. Since energy is a basic need, there is a need for mathematics to quantify energy dependency. This packet reviews some basic mathematical skills which enable the students to solve problems. This in turn should cause them to be more cognizant of their energy dependency in their environment.

Mathematical Objectives

Students should be able to:

1. Compute what fractional part one number is of another.
2. Compute fractional parts of whole numbers.
3. Reduce fractions to lowest terms.
4. Express a problem as a proportion.
5. Solve a proportion problem.
6. Add decimal fractions.
7. Subtract decimal fractions.
8. Multiply decimal fractions.
9. Divide decimal fractions.
10. Write numbers in scientific notation.
11. Solve for the unknown in a percent problem.
12. Compute the percent of increase and decrease.
13. Interpret line, bar and circle graphs.
14. Construct line, bar and circle graphs from given information.
15. Apply the above skills in consumer-related problems.

Energy Objectives

Students should be able to:

1. Judge the potential savings in fuel bills by using house insulation.
2. Identify energy that a family buys.
3. Define joule.
4. Identify energy savings (for a home).
5. Interpret increase and decrease in various energy consumption rates in personal and national situations.
6. Identify major changes in types and amounts of fuel consumption.
7. Analyze air pollution through its cost.

At the end of this packet you will find a post-test which has been constructed in segments. You may wish to use the segment on fractions as both a pre and post-test; or if it fits your needs better, use the post-test in its entirety as a final assessment following the completion of all the skill activities in this packet.

Key Terms

Joule - a metric unit of work or energy; the energy produced by a force of one newton operating through a distance of one meter. One BTU = 1055 joules, and one Calorie = 4185 joules.

Efficiency - the efficiency of an energy conversion is the ratio of the useful work or energy output to the work or energy input.

Per Capita - per person.

MPG - miles per gallon.

MPH - miles per hour.

Fossil Fuels - fuel such as coal, crude oil or natural gas, formed from the fossil remains of organic materials.

1. Fractions

Overview

Fractions are the topic of this skills activity. Students begin with a quick review of fractional parts of whole numbers and complete the lesson by solving a set of energy related problems involving proportions.

Mathematical Objectives

Students should be able to:

1. Compute what fractional part one number is of another.
2. Compute fractional parts of whole numbers.
3. Reduce fractions to lowest terms.
4. Express a problem as a proportion.
5. Solve a proportion problem.

Energy Objectives

Students should be able to:

1. Judge the potential savings in a fuel bill by using house insulation.
2. Identify energy that a family buys.

Target Audience

Junior High/Middle School Mathematics, Home Economics, Social Science.

Time Allotment

One-two class periods.

Materials

Student Worksheet for Lesson 1 from Student Guide.

Lesson 1
Student Worksheet

A. Fraction Review

Writing the Fractional Part of a Number

Sample Problems:

Reduce fractions to lowest terms.

6 is what fractional part of 8? $^{6}/_{8} = \frac{2\overline{)6}}{2\overline{)8}} = {}^{3}/_{4}$

5 is what fractional part of 3? $^{5}/_{3}$ or $1\ ^{2}/_{3}$

10 is what fractional part of 5? $^{10}/_{5}$ or 2

Practice Problems:

Reduce fractions to lowest terms.

1. 7 is what fractional part of 35? (1. $^{1}/_{5}$)
2. 11 is what fractional part of 66? (2. $^{1}/_{6}$)
3. 15 is what fractional part of 60? (3. $^{1}/_{4}$)
4. 6 is what fractional part of 2? (4. $^{3}/_{1} = 3$)
5. 120 is what fractional part of 280? (5. $^{3}/_{7}$)
6. 10 is what fractional part of 7? (6. $^{10}/_{7} = 1\ ^{3}/_{7}$)

Calculating a Part of a Whole

Sample Problems:

Reduce fractions to lowest terms.

What is $^3/_4$ of 8?

$$^3/_4 \times {}^8/_1 = \frac{3 \times 8}{4 \times 1} = {}^{24}/_4$$

$$\frac{4\overline{)24}}{4\overline{)4}} = {}^6/_1 = 6$$

What is $^5/_9$ of 27?

$$^5/_9 \times {}^{27}/_1 = {}^{135}/_9 = 15$$

What is $^3/_2$ of 8?

$$^3/_2 \times {}^8/_1 = {}^{24}/_2 = 12$$

Practice Problems:

Reduce fractions to lowest terms.

7. What is $^1/_2$ of 12? (7. 6)

8. What is $^2/_3$ of 15? (8. 10)

9. What is $^5/_6$ of 24? (9. 20)

10. What is $^9/_{10}$ of 150? (10. 135)

11. What is $^7/_{12}$ of 240? (11. 140)

12. What is $^5/_4$ of 12? (12. 15)

Proportion

Sample Problems:

$^3/N = {}^6/_8$

$$^3/N = {}^6/_8$$
$$6 \times N = 3 \times 8$$
$$6 \times N = 24$$
$$6N = 24$$
$$N = 4$$

$^7/_{10} = N/_5$

$$^7/_{10} = N/_5$$
$$10 \times N = 7 \times 5$$
$$10 \times N = 35$$
$$10N = 35$$
$$N = 3.5 \text{ or } 3\ ^1/_2$$

Note: You may want to introduce another method for solving proportion problems at this time. Students have a tendency to cross-multiply all problems.

Practice Problems:

13. $^{3}/_{4} = N/_{12}$ (13. $4 \times N = 36$, $N = 9$)

14. $^{7}/_{9} = {}^{14}/N$ (14. $7 \times N = 126$, $N = 18$)

15. $N/_{5} = {}^{3}/_{15}$ (15. $15 \times N = 15$, $N = 1$)

16. $^{24}/N = {}^{12}/_{13}$ (16. $12 \times N = 312$, $N = 26$)

E. Applications of Fraction Skills

1. An average home (if uninsulated) uses about 1600 gallons of fuel oil per year for heating. With full insulation, the amount of oil used is 900 gallons per year. How much oil used in the uninsulated house would be saved by insulating the home?[1] (1. 1600 - 900 = 700 gal saved)

2. A family making $14,000 per year spends $^{1}/_{20}$ of this amount on energy in one form or another, such as electricity, heat, light. How much do they spend on energy in one year?[1] (2. $^{1}/_{20} \times 14{,}000 = \$700$)

3. If a typical home with a roof area of 144 square meters receives 837×10^{10} joules of solar energy a year, how large an area would be needed to receive 628×10^{10} joules of solar energy a year? (3. $^{144}/_{837} \times 10^{10}\text{J} = N/_{628} \times 10^{10}\text{J}$; $837N = 90432$; $N = 108\ m^2$)

4. Rico's family of four has a monthly net income of $750.

   a. They spent $30 for electricity. What fractional part of their income is spent for this type of energy? (4a. $^{30}/_{750} = {}^{1}/_{25}$)

   b. The energy used to heat Rico's home comes from natural gas. If they spent $^{1}/_{30}$ of their income for heat, how much do they spend monthly? (4b. $^{1}/_{30} \times 750 = \$25$)

   c. Members of Rico's family get their muscle energy from food. $^{1}/_{5}$ of their monthly income is spent for food. How much do they spend for food energy per month? (4c. $^{1}/_{5} \times 750 = \$150$)

   d. They have a $100 car payment each month and they budget $25 per month on oil and gasoline for the car. What fractional part of the monthly income is spent on the car? What fractional part of the total car expense is spent on energy fuels? (Reduce fractions to lowest terms.) (4d. $100 + $25 = $125
   $^{125}/_{750} = {}^{1}/_{6}$ spent on car
   $^{25}/_{125} = {}^{1}/_{5}$ spent on fuel)

   e. Rico's family also spends $20 a month on other energy such as bus fares, school lunches, etc. What fractional part of the family's income is spent for total energy in the above problems? (4e.
   $ 30 electricity
   25 gas for heat
   150 food energy
   45 oil & gasoline
   $250 Total
   $^{250}/_{750} = {}^{1}/_{3}$)

2. Decimals

Overview	This lesson emphasizes adding, subtracting, multiplying and dividing decimal fractions and gives students practice in writing numerals in scientific notation.
Mathematical Objectives	Students should be able to: 1. Add decimal fractions. 2. Subtract decimal fractions. 3. Multiply decimal fractions. 4. Divide decimal fractions. 5. Write numbers in scientific notation.
Energy Objectives	Students should be able to: 1. Define joule. 2. Identify energy savings (for a home).
Target Audience	Mathematics, Home Economics, Social Science.
Time Allotment	One-two class periods.
Materials	Student Worksheet for Lesson 2 from Student Guide.

Lesson 2
Student Worksheet

A. Decimal Review

Addition and Subtraction of Decimal Numbers

Sample Problems:

$3.5 + 7.0 + 1.634 =$

$$\begin{array}{r} 3.5 \\ 7. \\ +\ 1.634 \end{array} \qquad \begin{array}{r} 3.500 \\ 7.000 \\ +\ 1.634 \\ \hline 12.134 \end{array}$$

$2.4 - .163 =$

$$\begin{array}{r} 2.4 \\ -\ .163 \end{array} \qquad \begin{array}{r} 2.400 \\ -\ .163 \\ \hline 2.237 \end{array}$$

● Practice Problems:

1. $8.7 + 1.34 + 6$ (1. 16.04)

2. $.417 + 3.2 + 7.56$ (2. 11.177)

3. $1.36 - .27$ (3. 1.09)

4. $.8 - .1725$ (4. .6275)

5. $\$6 + \$.34 + \$.70$ (5. \$7.04)

6. $\$2.30 - \$1.68$ (6. \$0.62)

Multiplication of Decimal Numerals

Sample Problems:

$.46 \times 3 =$

$$\begin{array}{r} .46 \\ \times\ 3 \\ \hline 1.38 \end{array}$$

Counting from right to left in the answer, put in as many decimal places as there are <u>total</u> decimal places in the problem.

$.13 \times .007 =$

$$\begin{array}{r} .007 \\ \times\ .13 \\ \hline 021 \\ +\ 007 \\ \hline .00091 \end{array} \qquad \begin{array}{l} (3 \text{ places}) \\ +(2 \text{ places}) \\ \\ \\ (5 \text{ places}) \end{array}$$

Practice Problems:

7. .37 x 5 (7. 1.85)

8. 1.46 x .7 (8. 1.022)

9. .724 x 6.1 (9. 4.4164)

10. .032 x 8.4 (10. .2688)

11. $2.48 x 19 (11. $47.12)

12. $63.20 x 75 (12. $4740.00)

Division of Decimal Numerals

Sample Problems:

1.26 : 7 =

$$7\overline{)1.26} = .18$$

12.42 : .3 =

$$.3\overline{)12.42} = 41.4$$

4.5 : .15 =

$$.15\overline{)4.50} = 30.$$

Practice Problems:

Round decimals off to two places.

13. 1.35 ÷ 5 (13. .27)

14. 62.1 ÷ 23 (14. 2.7)

15. 1.215 ÷ .9 (15. 1.35)

16. .2196 ÷ 6.1 (16. .036)

17. 1.095 ÷ .73 (17. 1.5)

18. 284 ÷ 7.1 (18. 40)

19. $153.75 ÷ 25 (19. $6.15)

20. $463.80 ÷ 3 (20. $154.60)

Writing Numerals in Scientific Notation

Sample Problems:

1,340,000,000 = 1.34×10^9 (count places from right to left)

580,000,000,000 = 5.8×10^{11}

Note: Scientific notation allows for easy handling of large numbers.

Practice Problems:

Write the following numbers in scientific notation.

21. 9,200,000 (21. 9.2×10^6)

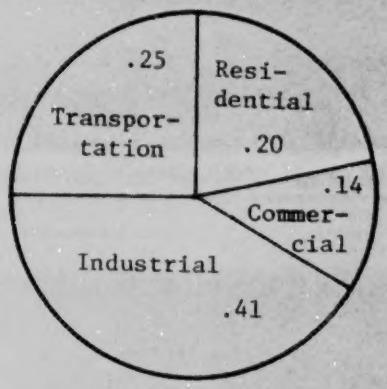
22. 217,000,000 (22. 2.17×10^8)

23. 6,342,000,000 (23. 6.342×10^9)

24. 7,080,000,000 (24. 7.08×10^9)

B. Applications of Fraction Skills

1. The circle graph below shows a breakdown of energy consumption by decimal part in the U.S.[1]



Note: In all problems round to the nearest hundredth unless directed otherwise.

Total U.S. energy consumption was approximately 78.2×10^{18} (Exajoules) in 1976. Using the decimal parts given in the graph, calculate the number of Exajoules used in each category.

(1. Transportation
$78.2 \times .25 = 19.55$ EJ

Residential
$78.2 \times .20 = 15.64$ EJ

Commercial
$78.2 \times .14 = 10.95$ EJ

Industrial
$78.2 \times .41 = 32.06$ EJ)

2. Much energy can be saved by wise usage. The following table shows potential energy savings through conservation.[1]

PRIMARY ENERGY SAVED
[In Exajoules (joules x 10^{18})]

Economy Measure	1977
Thermostat Setback Heating (68° day/60° night)	1.55
Water Heating (120°)	.63
Air Conditioner (78°)	.13
Reduce Hot water Use by $^1/_3$	.50
Furnace Tune-up	.63
Air Conditioner Tune-up	.96
Total	4.40

a. Write the number of joules saved by each economy measure in the chart as whole numbers. (i.e. 1.55 EJ = 1,550,000,000,000,000,000 J)

(a. Thermostat setback
1,550,000,000,000,000,000 J

Water heating
630,000,000,000,000,000 J

Air conditioning
130,000,000,000,000,000 J

Reduce hot water use by $^1/_3$
500,000,000,000,000,000 J

Furnace tune-up
630,000,000,000,000,000 J

Air conditioner tune-up
960,000,000,000,000,000 J)

b. Write the whole numbers in scientific notation.

(b. Thermostat setback
1.55×10^{18} J

Water heating
6.3×10^{17} J

Air conditioning
1.3×10^{17} J

Reduce hot water use by $^1/_3$
5.0×10^{17} J

Furnace tune-up
6.3×10^{17} J

Air conditioner tune-up
9.6×10^{17} J)

3. Homeowners can save money by insulating their homes properly. The following table shows the average number of joules saved by each type of investment.[1]

ENERGY SAVINGS FROM HOMEOWNER INVESTMENT
[In Exajoules (joules x 10^{18})]

Type of Investment	1977
Insulating ceilings	.75
Weatherstripping and caulking	.33
Installing storm windows and doors	.17
Total	1.25

a. Write the number of joules saved by each homeowner investment in the chart as whole numbers.

(a. 750,000,000,000,000,000 J

330,000,000,000,000,000 J

170,000,000,000,000,000 J)

b. Write the whole numbers in scientific notation.

(b. 7.5×10^{17}

3.3×10^{17}

1.7×10^{17})

4a. Find the total number of joules saved by conservation in Problem #2 and by insulation in Problem #3. Give your answer in scientific notation.

(4a. $[4.40 \times 10^{18}] + [1.25 \times 10^{18}] =$

5.65×10^{18} joules)

b. Using the number of exajoules of energy used for "Residential" found in Problem #1, find what decimal fraction part of the total in 4a would have been saved by the conservation measures.

(b. $^{5.65}EJ/_{15.64}EJ = {}^{565}/_{1564} =$ .36

5. A car travelling at 50 mph (miles per hour) averages 19.5 mpg (miles per gallon). The same car travelling at 60 mph averages 17.5 mpg. The car travels 600 miles in one day.

a. How much fuel will it use at 50 mph? At 60 mph?

(5a. 600 ÷ 19.5 = 30.77 gal at 50 mph

600 ÷ 17.5 = 34.29 gal at 60 mph)

b. If gasoline costs $ .65/gal, how much would it cost to travel the 600 miles at 50 mph? At 60 mph?

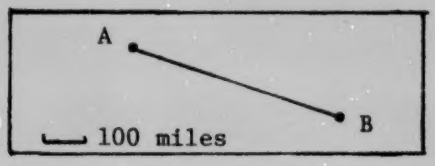
(b. 30.77 x .65 = $20.00 at 50 mph

34.29 x .65 = $22.29 at 60 mph)

c. How much money would one save driving at 50 mph for 600 miles rather than at 60 mph for 600 miles?

(c. $22.29 - $20.00 = $2.29)

6. Two cities, Atlas and Beeville are 500 miles apart. A trucking company is under contract to deliver goods from A to B and from B to A.



a. If a truckdriver receives $15.00/hr, how much would he earn at 65 mph and at 55 mph respectively for the round trip?

(a. 1000 ÷ 65 = 15.38 hr

15.38 hr x 15 = $230.70 earned at 65 mph

1000 ÷ 55 = 18.18 hr

18.18 hr x 15 = $272.70 earned at 55 mph)

b. How much more will the company have to pay the driver going the lowered speed limit?

(b. $272.70 - $230.70 =

$42.00 increased cost to company for wages)

c. At 65 mph, a truck gets 6.2 mpg and at 55 mph the same truck gets 7 mpg. What is the cost of gasoline at the two rates for the 1000 miles (round trip) if gasoline costs $ .52 per gallon?

(c. 1000 ÷ 7 = 142.86 gal at 55 mph)

142.86 x $ .52 = $74.29

1000 ÷ 6.2 = 161.29 gal at 65 mph

161.29 x $ .52 = $83.87)

d. What is the decrease in cost of gasoline to the company by travelling slower?

(d. $83.87 - $74.29 = $9.58 decreased cost of gasoline)

e. What total will the company probably have to pay as a result of the decreased speed limit?

(e. $42.00 - $9.58 = $32.42 more cost to company)

f. How did the decreased speed limit affect the amount of energy used?

(f. Less energy consumed.)

3. Percents

Overview	In this lesson students review the three basic types of percentage problems and learn how to solve for the unknown in a percent problem. In addition, they will figure the percent of increase (or decrease) in a set of sample problems and then apply this computational skill to a series of energy related questions.
Mathematical Objectives	Students should be able to: 1. Solve for the unknown in a percent problem. 2. Compute the percent of increase and decrease.
Energy Objectives	Students should be able to: 1. Interpret increase and decrease in various energy consumption rates in personal and national situations.
Target Audience	Mathematics, Social Science.
Time Allotment	One-two class periods.
Materials	Student Worksheet for Lesson 3 from Student Guide.

Lesson 3
Student Worksheet

A. Percent Review

Three Basic Types of Percent

Sample Problems:

Round answer to nearest hundred.

21% of 65 is N

$$\frac{21}{100} = \frac{N}{65}$$

$$100 \times N = 21 \times 65$$
$$100 \times N = 1365$$
$$100N = 1365$$
$$100\overline{)1365}$$
$$N = 13.65$$

or

(.21)65 = N

21% = .21

$$\begin{array}{r} 65 \\ \times .21 \\ \hline 65 \\ 130 \\ \hline 13.65 \end{array}$$

N% of 5 is 2

$$\frac{N}{100} = \frac{2}{5}$$

$$5 \times N = 2 \times 100$$
$$5 \times N = 200$$
$$N = 40\%$$

or

$\frac{N}{100}$ (5) = 2

$$\begin{array}{r} .40 \\ 5\overline{)2.00} \\ \underline{2\ 0} \\ 0 \\ \underline{0} \end{array} = 40\%$$

24

35% of N is 21.7

$35/100 = 21.7/N$

$35 \times N = 100 \times 21.7$
$35 \times N = 2170$
$N = 62$

or

$.35N = 21.7$

$35\% = .35$

$$.35\overline{)21.70}\quad 62.$$

Practice Problems:

1. 12% of 610 is N (1. N = 73.2)
2. 3% of 75 is N (2. N = 2.25)
3. 3 is N% of 5 (3. N = 60%)
4. N% of 6 is 12 (4. N = 200%)
5. 2% of N is 6 (5. N = 300)
6. 75% of N is 216 (6. N = 288)

Percent of Increase or Decrease

Sample Problems:

What is the percent of increase from 5 to 9?

(difference between 5 & 9)

$N/100 = 4/5$

(original amount)

$5 \times N = 4 \times 100$
$5 \times N = 400$
$5N = 400$
$N = 80\%$ increase

What is the percent of decrease from 25 to 18?

(difference between 25 & 18)

$N/100 = 7/25$

(original amount)

$25 \times N = 7 \times 100$
$25 \times N = 700$
$25N = 700$
$N = 28\%$ decrease

25

7. What is the percent of increase from 4 to 6?

(7. $6 - 4 = 2$

$^{2}/_{4} = N/_{100}$

$N = 50\%$ increase)

8. What is the percent of decrease from 8 to 5?

(8. $8 - 5 = 3$

$^{3}/_{8} = N/_{100}$

$N = 37.5\%$ decrease)

9. What is the percent of increase from \$1.25 to \$1.50?

(9. \$1.50 - \$1.25 = \$ .25

$^{.25}/_{1.25} = N/_{100}$

$N = 20\%$ increase)

10. What is the percent of decrease from \$4.00 to \$2.60?

(10. \$4.00 - \$2.60 = \$1.40

$^{1.40}/_{4.00} = N/_{100}$

$N = 35\%$ decrease)

B. Applications of Percent

1. Mrs. Grey drives her car an average of 200 miles per week and uses 20 gallons of gasoline. She wants an auto that will travel the same distance but use 20% less fuel. How much fuel will she then use per week?

(1. $^{20}gal/_{100}\% = N\ gal/_{20}\%$

$N = 4\ gal$

20 gal - 4 gal = 16 gal)

2. A car uses 100% more gasoline than a motorcycle. If the motorcycle travels 100 miles and uses two gallons of gasoline, how much would the car use to travel the same distance? (Hint: 2 gallons represents 100% for the motorcycle.)

(2. $N/_{200} = {}^{2}/_{100}$

$N = 4\ gal$)

3. After having a motor tune-up on her car, Mrs. Hatch's mpg increased from 15 to 18. What was the percent of increase?

(3. $N/_{100} = {}^{3}/_{15}$

$N = 20\%$)

4. Miss Redlin drives her car 20 miles per day to work. In the winter, because of the ice and snow, her mpg decreases from 18 to 14. What is the percent of decrease?

(4. $18 - 14 = 4$

$^{4}/_{18} = N/_{100}$

$18N = 400$

$N = 22.22\%$)

5. During the year Mr. and Mrs. James' light and gas bill increased 15%. If the average cost prior to the increase was $60 per month, how much do they pay after the increase?

(5. $N = \$60 + [15\%\ of\ \$60]$
$N = \$60 + [\ .15 \times \$60]$
$N = \$60 + \$9$
$N = \$69$)

6. The cost of a barrel of imported crude oil in 1974 was 300% of the cost of a barrel of imported oil in 1973. If a barrel of imported crude oil cost $12.52 in 1974, what was the cost of a barrel of oil in 1973?
(Hint: 1973 cost = 100%)

(6. $N/_{12.52} = {}^{100}/_{300}$

$N = \$4.17$)

7. Emission control standards for cars manufactured since 1970 require that carbon monoxide (CO) in exhaust fumes should not exceed 4%. A recent test of a 1974 car indicated that 150,000 cubic centimeters (cm^3) of an exhaust sample contained 7,000 cubic centimeters of CO.

   a. Determine how many cubic centimeters of CO equals 4%.

   (7a. $150{,}000\ cm^3 \times .04 = 6000\ cm^3$)

   b. Determine by how many cubic centimeters the CO must be reduced to meet the 4% requirement.[3]

   (7b. $7000 - 6000 = 1000\ cm^3$)

8. A drop in speed from 70 mph to 50 mph increases the gasoline mileage by 20%. If your car can average 25 mpg at 70 mph, what mileage will your car get if you drive at 50 mph?[1]

   (8. [20% of 25] + 25 = N
   [.20 x 25] + 25 = N
   5 + 25 = N = 30 mpg)

9. To conserve energy, Mr. Beamer has decided to install a solar heating system in his home. The cost, excluding taxes and finance charge, is $5000. This installation will reduce his utility bill 60%. Presently his utility bill averages $700 per year.

   a. How much money will be saved yearly after the installation?

   (9a. 60% of $700 = $420 saved)

b. If the federal government provides a tax credit of 40% on the first $1000 and 25% on the principal balance, what is the total tax credit provided by the government on the $5000 system?

(b. [40% of 1000] + [25% of 4000] = N

N = $1400)

c. How long will it take the savings in the utility bill to pay for Mr. Beamer's reduced cost of $3600? (Assume the average utility bill will remain constant.)

(c. $\$^{3600}/\$_{420}$ = 8.57 yr)

10. "Joule" Energy has just graduated from high school. She has a scholarship to B.T.U. in the fall, but until then she lives with her parents. She just purchased a 1976 Camaro (used). She has taken a job at the local gas station for $2.90 per hour. "Joule" works eight hours per day, five days per week. How much does she earn per week? Per month?

(10. $116 per week, $464 per month)

She has a budget plan for her earnings for the month as follows:

Entertainment	$ 90.00
Car payment	110.20
Snacks	20.00
Gasoline	50.00
Other needs	8.20
Clothing	30%
Savings	10%

a. How much did "Joule" save each month?

(10a. $ 46.40 per month)

b. How much did she spend on clothing?

(10b. $139.20 per month)

c. Which two items listed represent direct use of energy? (10c. gasoline, snacks)

d. How much money was spent for energy? (10d. $70.00 per month)

e. What percent of her monthly earnings did she spend for energy? (10e. 15%)

f. "Joule" spent $50 for gasoline. At 69.9¢ per gallon, how many gallons of gasoline did she purchase? (10f. 71.53 gal)

g. If "Joule's" car can travel 22 miles on one gallon of gasoline, how many miles did she travel on the total amount of gasoline purchased? (10g. 1573.66 mi)

11. The President's Seven Energy Goals for 1985 as stated in his speech to Congress on April 12, 1977 are as follows:

I. Reduce the annual growth rate in our energy consumption to less than 2%.

II. Reduce gasoline consumption by 10%.

III. Cut imports of foreign oil to less than 6 million barrels a day, less than half the amount that we will be importing if we do not conserve.

IV. Establish a strategic petroleum reserve supply of at least 1 billion barrels, which will meet our needs for about 10 months.

V. Increase our coal production by more than two-thirds, to cover one billion tons a year.

VI. Insulate 90% of American homes and all new buildings.

VII. Use solar energy in more than 2 $^{1}/_{2}$ million American homes.[4]

a. In 1975, energy consumption in the United States was $.74 \times 10^{18}$ joules. If consumption had grown by only 2% what would 1976 consumption have been? (11a. .74EJ x .02 = .01EJ
.74 + .01 = .75EJ)

30

b. 1976 consumption was $.78 \times 10^{18}$ joules. What was the real growth rate?

(11b. .78EJ - .74EJ = .04EJ

$.04/.74 = N/100$

$4 = .74N$

$5.40 = N$ or 5.4%)

c. If the present gasoline consumption is about 100 billion gallons a year, how many gallons of gasoline will be consumed after the 10% reduction?

(11c. [100 billion gal - {10% of 100 billion gal}] = N

$N = 100 - 10$

$N = 90$ billion gal)

d. The forecasts in the National Energy Plan show the amount of imported petroleum could be as much as 11 million barrels per day by 1980.[4] The President would like to limit the amount of imported oil to less than 6 million barrels per day. If we are able to decrease our imports from 11 million to 6 million barrels per day, what would be the percent of decrease in imported oil?

(11d. $\frac{\text{11 million bbl - 6 million bbl}}{\text{11 million bbl}} = \frac{5}{11} = \frac{N}{100}$

$N = 45.5\%$ decrease)

e. If a billion barrels of oil is enough reserved oil to last the U.S. for 10 months, how much oil do we need per month? Per day?

(11e. 100 million bbl per mo = 3.3 million bbl per day)

f. Despite the need to encourage production of domestic forms of energy, the supply of coal dropped from 595 million tons in 1972 to 590 million tons in 1973. President Carter would like to have the industry increase their production to 1 billion tons.[4] What percent of increase from the 1973 level would this require?

(11f. $\frac{\text{[1 billion - 590 million tons]}}{\text{590 million tons}} = \frac{N}{100}$

$\frac{410}{590} = \frac{N}{100}$

$N = 70\%$ increase)

g. If there are approximately 70 million American homes, how many must be insulated by 1985 if we are able to insulate 90% by that time?

(11g. 90% of 70 million = 63 million)

h. In 1976 there were 500 homes heated by solar energy. President Carter proposes that 2.5 million homes be heated by solar energy by 1985.[4] What is the increase in percentage of homes heated by solar energy between 1976 and 1985?

(11h. $N/_{100} = {}^{2,500,000}/_{500}$

N = 5,000% increase)

4. Graphing It

Overview

This lesson helps to develop the student's skills in interpreting information on a bar graph, line graph, and circle graph. It also helps them apply these skills by having them use data in a table and constructing a set of graphs. In addition they should learn some important quantitative facts about energy by working with graphs which show information quickly.

Mathematical Objectives

Students should be able to:

1. Interpret line, bar, and circle graphs.
2. Construct line, bar, and circle graphs using given information.
3. Apply graph-making skills in solving consumer and energy-related problems.

Energy Objectives

Students should be able to:

1. Identify major changes in types and amounts of fuel consumption.
2. Analyze air pollution through its costs.

Target Audience

Mathematics.

Time Allotment

Three-four class periods.

Materials

Student Worksheet for Lesson 4 from Student Guide.

Teaching Strategies

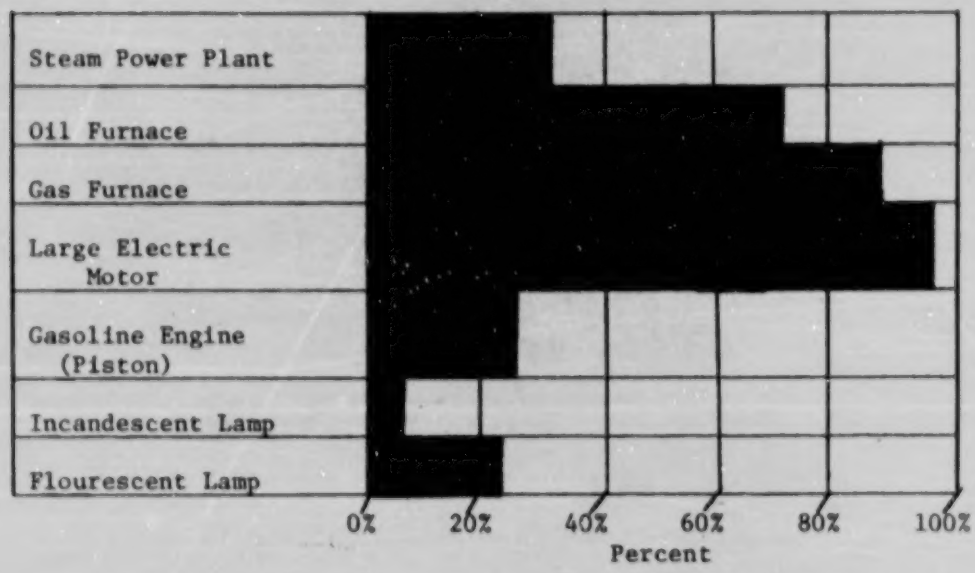
Introduce efficiency in this lesson. Ask the class to think of some ways they can use this word in relation to a car engine. Efficiency is measured by a comparison of the output (in energy, time, money, etc.) with the input of the same quantity.

Discuss the concept of work as calculated through: Force x Distance = Work.

Lesson 4
Student Worksheet

1. The "efficiency" of an energy source is measured by a comparison of the output (in energy, time, money, etc.) with the input of the same quantity. The following bar graph shows:

PERCENTAGE OF ENERGY USED WHICH IS CONVERTED TO USEFUL WORK



a. What percent of energy is converted to useful work for each plant, furnace, etc.?

(a. Steam Power Plant 33%
Oil Furnace 74%
Gas Furnace 88%
Large Electric Motor 98%
Gasoline Engine (Piston) 25%
Incandescent Lamp 6%
Flourescent Lamp 23%)

b. Which of the above energy sources is most efficient?

(b. Large electric motor is most efficient.)

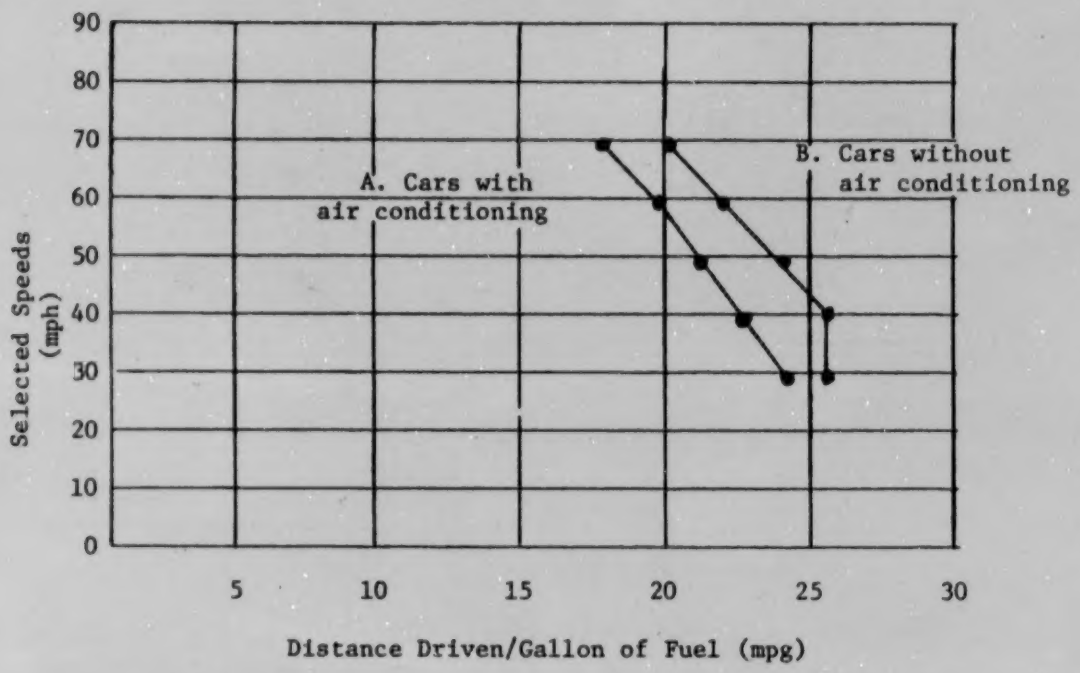
c. Least efficient?

(c. Incandescent lamp is least efficient.)

d. Discuss the efficiency of each energy source. What causes them to be less efficient?

(d. General reasons for lesser efficiency:
--amount of heat loss
--amount of friction
--energy of another type produced [other than type being measured for purpose intended])

2. EFFECT OF SPEED ON FUEL CONSUMPTION RATES



a. At what speeds will Cars A and B travel farther on one gallon of fuel?

(a. Car A: 30 mph
Car B: 30 to 40 mph)

b. What will be the rate of fuel consumption when the cars travel at their minimum fuel consumption rate according to the graph? (Hint: 1 gal per ___ mi (at 30 mi/hr))

(b. Car A: 1 gal per 24 mi
Car B: 1 gal per 26 mi)

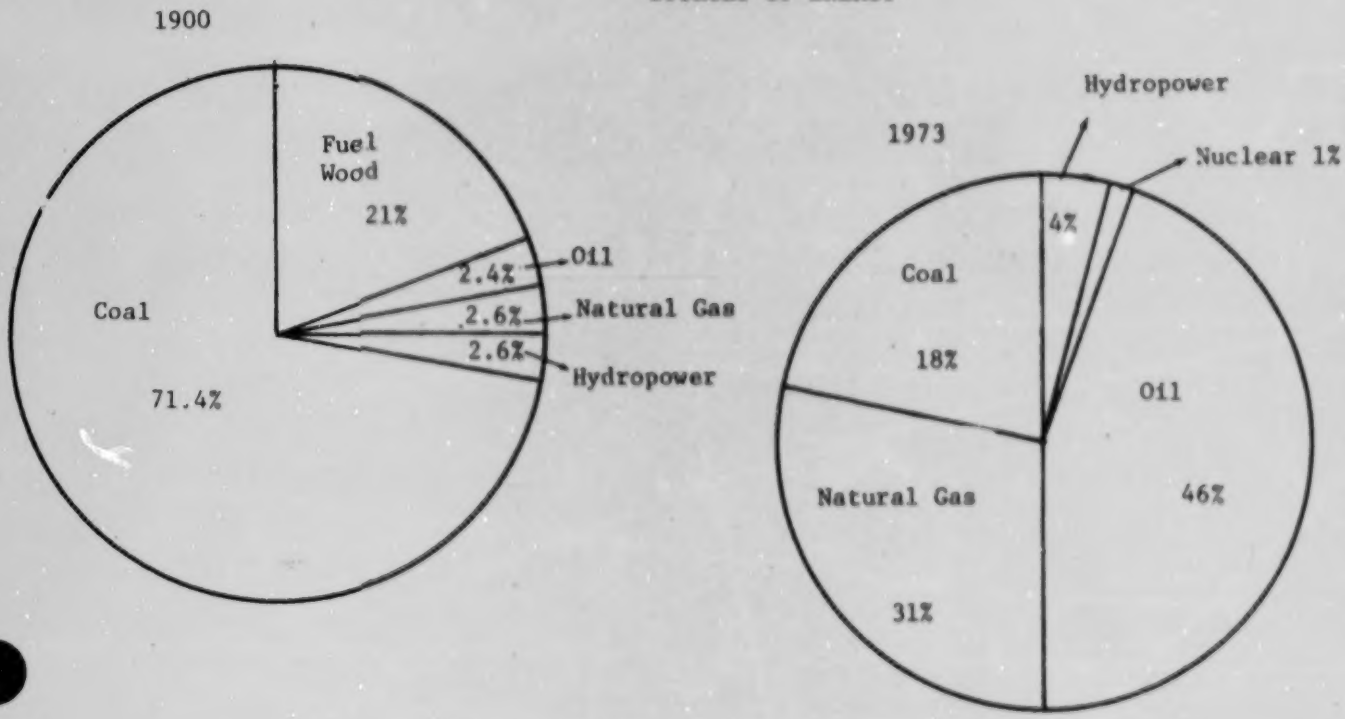
c. At 55 mph what is the fuel consumption rate for each car?

(c. Car A: 1 gal per 21 mi
Car B: 1 gal per 23 mi)

36

3. Study the two circle graphs below and answer the questions which follow.

SOURCES OF ENERGY[1]



a. In 1900 which source of fuel was used most? (a. Coal)

b. What source of fuel was used in 1900 but not in 1973? (b. Fuel wood)

c. What source of fuel was used in 1973 but not in 1900? (c. Nuclear)

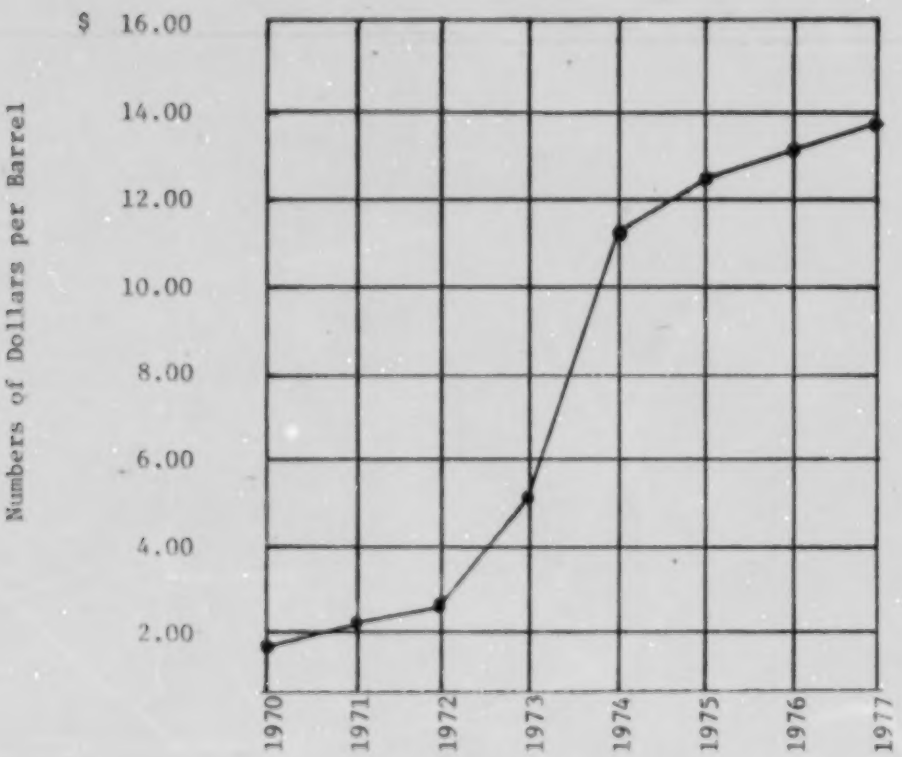
d. In your opinion, why was more natural gas used in 1973 than in 1900? (d. Possible answers: Industrialization-more capable of obtaining it.)

B. Constructing Graphs

4. The American Energy Crisis occurred in 1973 and 1974. The Organization of Petroleum Exporting Countries (OPEC) forced oil prices upward to gain control of the market. They then placed an oil embargo on the oil imported by the United States. The result was a tremendous increase in oil prices. In 1971 the price began to rise.

Year[5]	Cost[5]
1970	$ 1.80
1971	2.18
1972	2.48
1973	5.18
1974	11.25
1975	12.38
1976	13.00
1977	13.50

Make a line graph (in the space below) to show the trend in oil prices from 1970 to 1977.

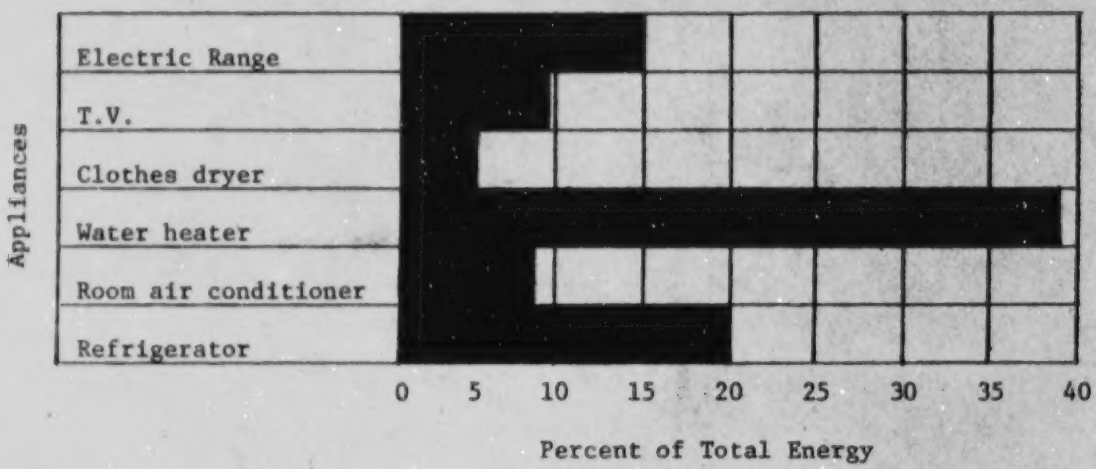


5. Listed below are the percents of total energy used by the most common appliances in the home/year.[1]

Electric range	15%
T.V.	9%
Clothes dryer	5%
Water heater	38%
Room air conditioner	8%
Refrigerator	20%

a. In the space below construct a bar graph of the information given above.

ENERGY USED BY HOME APPLIANCES



b. Which appliance(s) uses the most energy? (b. water heater)

c. Which appliance(s) uses the least? (c. clothes dryer)

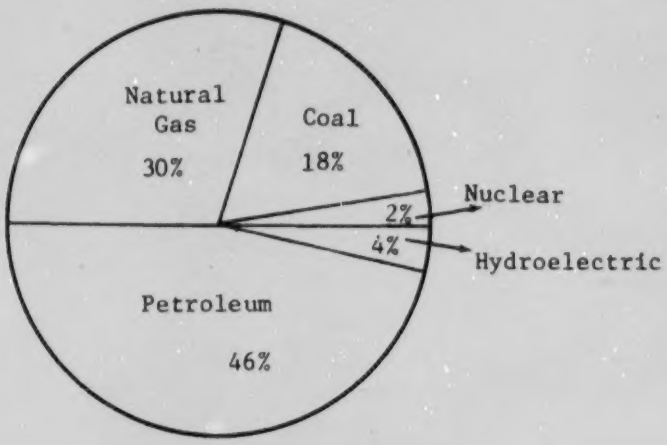
d. Can you think of ways to conserve the energy used by these appliances? (d. 1. Construct the heating and cooling appliances with more insulation.
2. Use clothes dryer only with full loads, use clothes line.
3. Turn down heat setting of water heater.
4. Use less T.V., air conditioning.
5. Only open refrigerator when necessary; take all needed items out at one time.
6. Etc.)

39

6. a. Make a circle graph in the space below to show the United States' use of Energy Resources in 1974.

Energy Source[6]	Percent of Energy[6]
Petroleum	46%
Natural gas	30%
Coal	18%
Nuclear	2%
Hydroelectric	4%

Note: Estimate the size of the sections of the circle.



b. What percent of the above energy comes from fossil fuels? (b. 94%)

7. It was estimated that the total cost for air pollution in 1968 was $16.2 billion. A partial breakdown of these costs include:

   $6.1 billion for health effects
   $4.8 billion for effects on materials (rust, corrosion, damage to fabrics, cost of protective coating, etc.)
   $5.2 billion for damage to residential property (including reduction in value)
   $0.12 billion for damage to commercial crops[1]

Round all answers to tenths.

a. Determine the percentage of the total cost that each category represents.

(a. Health effects
$6.1/16.2 = 37.7\%$

Effects on materials
$4.8/16.2 = 29.6\%$

Damage to residential property
$5.2/16.2 = 32.1\%$

Damage to commercial crops
$.12/16.2 = .7\%$)

b. Determine the number of degrees of a circle that each percentage (in problem "a" above) represents. (There are 360° in a circle.) Round off to nearest whole degree.

$\%/100 = N°/360°$

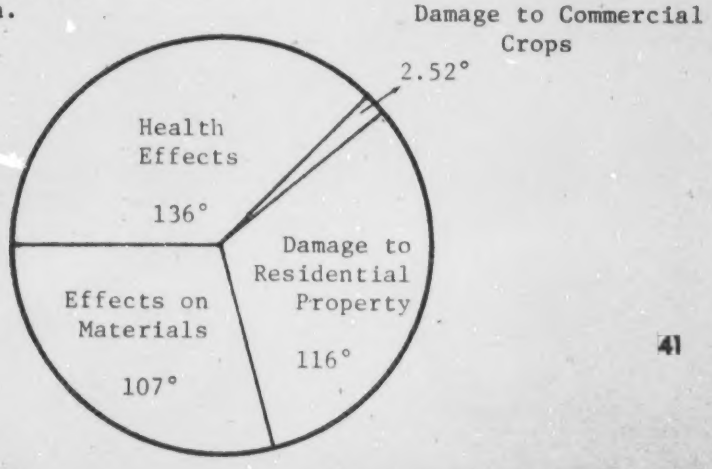
(b. Health effects
$.377 \times 360° = 136°$

Effects on materials
$.296 \times 360° = 107°$

Damage to residential property
$.321 \times 360° = 116°$

Damage to commercial crops
$.007 \times 360° = 3°$)

c. Show this information in the form of a circle graph.



41

d. Find the total of the degrees shown in the circle graph. Why is the total not 360°?

(d. 362°. Rounding up added 2°.)

e. Assume the population of the United States was 2.025×10^8 in 1968. What was the per capita cost of air pollution (to the nearest cent)?

(e. Cost per capita
$(16.2 \times 10^9) \div (2.025 \times 10^8)$
or
$16{,}200{,}000{,}000 \div 202{,}500{,}000 =$
$80.10)

42

Facts About Energy

Energy received by a field (approximately 1 acre or .04 hectare) from the sun	= 66,880 megajoules
1 megajoule	= 1 million joules
Power of a human at rest	= .06 x 10^6 joules
Human walk for 5 seconds	= 1000 joules
200 calorie candy bar	= 836800 joules
Energy released by burning 1 kg of wood	= 11.5 million joules
Energy released by burning 1 kg of coal	= 30.4 million joules
Energy released by burning 1 kg of gasoline	= 43.8 million joules
Energy needed to melt 1 kg of ice	= 331372.8 joules
Energy needed to manufacture one automobile	= 21756.8 x 10^6 joules
Energy needed to evaporate 1 kg of water	= 2255176 joules
4184 joules	= 1 Calorie
Acceleration of a free-falling object here on Earth	= 9.8 meters/sec^2
Number of joules needed to light one 1-watt bulb for 40 hours	= 9623.2 joules
Work	= force x distance
Energy	= the ability to do work
Newton	= a unit to force
Mass (kg) x 9.8 Newtons/sec^2	= weight (Newtons)
1 Newton-Meter (force x distance)	= 1 joule (work or energy)

Student Activity 1

The following problems deal with population and energy consumption in the United States from 1920 to 1970.

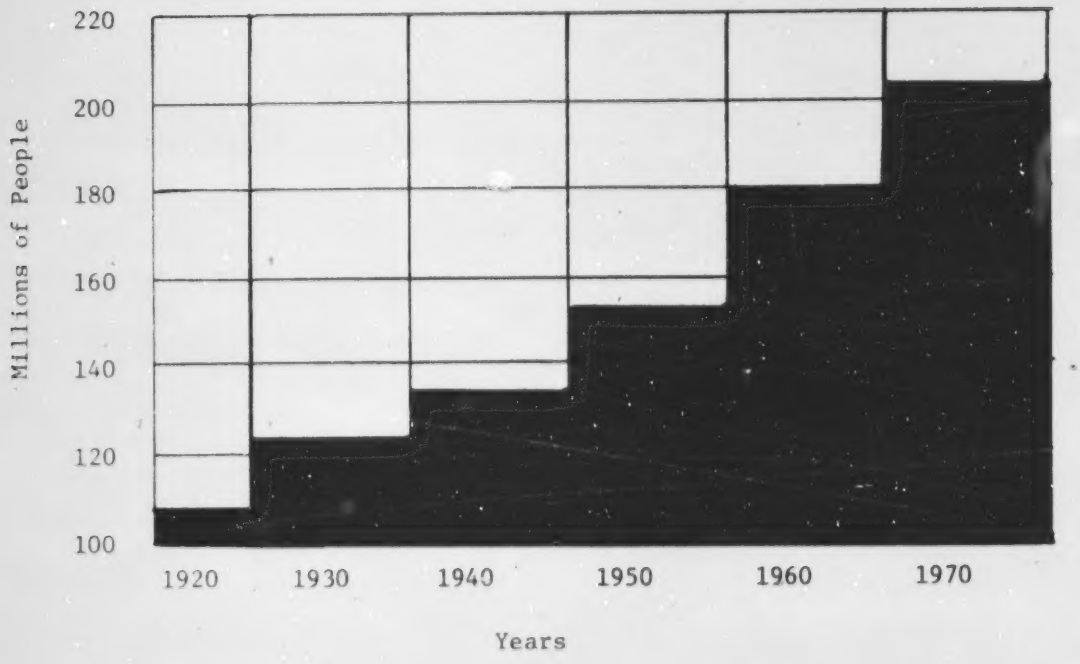
a. Research for total population figures of the United States from 1920 to 1970. List the statistics for each decade and write the numerals in word form.

(a.

Year[7]	Population[7]
1920	1.06×10^8= 106 million
1930	1.23×10^8= 123 million
1940	1.32×10^8= 132 million
1950	1.52×10^8= 152 million
1960	1.80×10^8= 180 million
1970	2.03×10^8= 203 million)

b. Make a bar graph to show the data.

b. POPULATION STATISTICS



c. Do research to find the per capita energy consumption for each decade.[2]

(c.

Year	Energy Use Per Capita in Joules
1920	3.89×10^{11}
1930	3.81×10^{11}
1940	3.81×10^{11}
1950	4.69×10^{11}
1960	5.19×10^{11}
1970	6.86×10^{11})

d. Compute the percent of increase in energy use per capita from 1920 to 1970.

(d. $[6.86 \times 10^{11}] - [3.89 \times 10^{11}] = 2.97 \times 10^{11}$

$2.97 \times 10^{11} / 3.89 \times 10^{11} = 76\%$)

e. Considering the trend from 1920 to 1970 in part c, project the energy consumption per capita from 1970 to 1980.

(e. Increase from 1940 to 1950 - 87864 megajoules

Increase from 1950 yo 1960 - 50208 megajoules

Increase from 1960 to 1970 - 167360 megajoules

Increase from 1970 to 1980 - ? [for discussion])

f. Considering the trends in the population statistics from 1920 to 1970, what do you estimate the population to be by 1980?

(f. Increase from 1940 to 1950 - 20 million people

Increase from 1950 to 1960 - 28 million people

Increase from 1960 to 1970 - 23 million people -

Increase from 1970 to 1970 - ? [for discussion])

g. What is the total number of joules of energy needed to supply the 1980 population from 1970 to 1980?

(g. Number of joules needed will have to be determined from predictions in parts e and f.)

45

Student Activity 2

Weight lifting and running are two activities that athletes participate in when training. Use information on page 43.

a. If an athlete lifts a 980 Newton weight through a distance of 2.5 meters, 10 times, how much work in joules did s/he do?

(a. work = [980 Newtons][2.5m][10]
= 24500 joules)

b. Did the athlete [in "a"] use enough energy to light a 1-watt bulb? If not, how much more energy would s/he need to use? If so, for how many hours would the bulb stay lit?

(b. Yes. 9623.2 joules will light one 1-watt bulb for 40 hours.

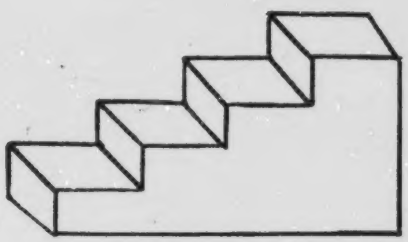
$$\frac{9623.2 \text{ joules}}{40 \text{ hours}} = 240.58 \text{ joules/hr}$$

$$\frac{24500 \text{ joules}}{240.58 \text{ joules/hr}} = 101.84 \text{ hr})$$

c. If the athlete who weighs 980 Newtons runs up stairway "A" five times, does s/he do as much work as s/he did when lifting the weight?

(c. [980 Newtons][4 meters][5] =
19600 joules

Since 19600 < 24500, no.)



Stairway A

Student Activity 3

The following activity is related to the automobile. The object is to find the energy, in the form of fuel, needed to operate the vehicle, and then, by conversions, to calculate the number of batteries needed to operate the vehicle. (Note: If you do not drive a car, you will need the cooperation of a person who will keep a record for you.)

Procedure:

I. a. Fill the gas tank of the automobile at the beginning of the week. Record the odometer reading at this time. (a. Student Activity)

b. Fill the tank seven days later to determine the gallons of gasoline used. (If additional gas was purchased during the week, be sure to add the number of gallons.) (b. e.g. 14 gallons of gasoline purchased)

c. Record the odometer reading at the end of the week. (c. Student activity)

d. Subtract the odometer readings to determine the number of miles travelled. (d. e.g. 280 miles for the week.

e. Compute the number of miles per gallon for the car. (e. e.g. 280 miles ÷ 14 gallons = 20 mpg)

f. Compute the average number of miles travelled per day. (f. e.g. 280 miles ÷ 7 days = 40 miles per day)

g. Compute the average number of gallons used per day. (g. e.g. 40 miles/day ÷ 20 mpg = 2 gallons/day)

Date	Odometer	Gallons

47

h. The energy contained in one gallon gasoline is approximately equivalent to the energy contained in 50 batteries. However, the efficiency of a battery is about 90%, while the efficiency of a gasoline powered engine is only about 20%. How many times as efficient is the battery than the gasoline powered motor? Therefore, the number of batteries needed to provide the energy of one gallon of gasoline would be divided by this efficiency number, $4\ ^1/_2$. N = _____. The energy of how many batteries would be needed for the miles travelled in one day?

(h. 90% ÷ 20% =
$4\ ^1/_2$ times as efficient

$50 \div 4\ ^1/_2 = N$

N = approximately 12 batteries for one gallon of gasoline.

The car requires approximately 2 gallons of gasoline per day which would be equivalent to 24 batteries.)

i. One battery measures about $^1/_2$' (15 cm) by $^3/_4$' (22.5 cm) by 1' (30 cm). What is the volume ofthe battery? (Hint: v = w x h x 1) How many cubic meters does the v =?

(i. $v = {}^1/_2 \times {}^3/_4 \times 1 =$
$^3/_8$ cubic feet

{15 cm x 22.5 cm x 30 cm =
10125 cm^3

10125 cm^3 = .01 m^3})

j. How many cubic meters of space would be needed for the batteries for energy for one day?

(j. 24 x .01 m^3 = .24 m^3)

*k. Build a cardboard model of this volume (in a practical shape) to show the space needed for the batteries to operate the car for one day. (This could be a scale model and could include the design of an automobile of the future.)

(k. Student Activity {optional})

*Indicates optional or more challenging problem.

II. Problems Relating to the Metric System:

a. Convert the numbers of miles travelled per day to kilometers.

(a. 40 mi per day x 1.6 = 64 km)

b. Convert the number of gallons of gasoline to liters.

(b. 2 gal gasoline per day

1 liter = .2642 gal

$^{1}/_{.2642} = {}^{x}/_{2}$

$.2642x = 2$

$x = 7.6$ liters)

c. Compute the number of kilometers per liter.

(c. kilometers/liter = $^{64}/_{7.6}$ = 8.4 km/liter)

49

PRE/POST TEST

I. Fractions

Solve the following problems. (Give answers in simplest form.)

1. 6 is what fractional part of 15? (1. $^{2}/_{5}$)

2. 2 is what fractional part of 100? (2. $^{1}/_{50}$)

3. 18 is what fractional part of 12? (3. $^{3}/_{2}$)

4. What is $^{1}/_{5}$ of 35? (4. 7)

5. What is $^{4}/_{7}$ of 28? (5. 16)

6. What is $^{7}/_{10}$ of 40? (6. 28)

7. Solve for N: $N/_{9} = {}^{20}/_{36}$ (7. N = 5)

8. Solve for N: $^{6}/_{8} = {}^{30}/N$ (8. N = 40)

9. Hydrocarbons make 15% of the pollution in the air caused by the automobile. What fractional part of the total pollution caused by the auto is this? (9. $^{15}/_{100} = {}^{3}/_{20}$)

10. The percent of nitrogen oxides in the pollutants caused by the automobile is $^{2}/_{3}$ of the percent of the pollution caused by hydrocarbons. What percent of the total is caused by nitrogen oxide? (Refer to previous problem.) (10. $^{2}/_{3}$ of 15 = 10, 10%)

II. Decimals Solve the following problems.

1. $1.2 + .7 + 13.4$ (1. 15.3)

2. $.75 - .346$ (2. .404)

3. 5×1.4 (3. 7)

4. $1.2 \times .06$ (4. .072)

5. $3.25 \div 5$ (5. .65)

6. $?.25 \div .15$ (6. 15)

7. Write in scientific notation: 500,000 (7. 5.0×10^5)

8. Write in scientific notation: 1,340,000,000 (8. 1.34×10^9)

9. In 1969, accidental spills, such as collisions, oil blow-outs, etc., accounted for 10% of the total oil pollution in the ocean. If 200,000 tons were contributed by these accidents, what was the total number of tons of oil pollution in the ocean? (9. 10% of N = 200,000
N = 2,000,000)

10. The total energy potential from solid waste (garbage), if converted to oil, could provide 20% of our current oil consumption. If our current oil consumption is 5.5 billion barrels per year, how much oil could be provided by garbage? (10. 1.1 billion)

III. Percents Solve the following problems.

1. 15% of 325 = N (1. 48.75)

2. 130% of 20 = N (2. 26)

3. 5 is N% of 15 (3. $33\ ^1/_3\%$)

4. 30 is N% of 25 (4. 120)

5. 45% of N = 90 (5. 200)

6. 25% of N = 400 (6. 1600)

7. What is the percent of increase from 6 to 10? (7. $66\ ^2/_3\%$)

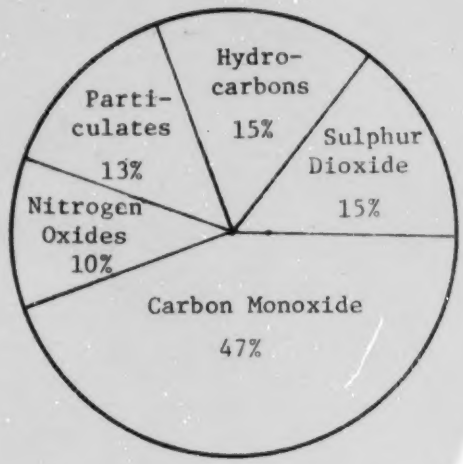
8. What is the percent of decrease from 15 to 10? (8. $33\ ^1/_3\%$)

9. In 1960, the cost of gasoline was $ .30/gal and in 1977 the cost was $ .70/gal. What was the percent of increase? (9. $133\ ^1/_3\%$)

10. Insulation of a home decreases the heating bill approximately 20%. How much was Mr. Page's bill prior to insulating his home if his present bill is $300.00 per year? (10. 80% of N = 300
N = 375)

IV. Graphing

It has been determined that the total cost for air pollution in 1968 was $16.2 billion, or approximately $80 for each person in the U.S. Information pertaining to air pollution is expressed in the form of a graph.



1. What fractional part of the circle is represented by hydrocarbons? (1. $^{3}/_{20}$)

2. How many degrees of the circle are represented by carbon monoxide? (2. 169.2°)

Student Guide

Lesson 1
Student Worksheet

Writing the Fractional Part of a Number

Sample Problems:

Reduce fractions to lowest terms.

6 is what fractional part of 8? $^6/_8 = \frac{2\overline{)6}}{2\overline{)8}} = {}^3/_4$

5 is what fractional part of 3? $^5/_3$ or 1 $^2/_3$

10 is what fractional part of 5? $^{10}/_5$ or 2

Practice Problems:

Reduce fractions to lowest terms.

1. 7 is what fractional part of 35?

2. 11 is what fractional part of 66?

3. 15 is what fractional part of 60?

4. 6 is what fractional part of 2?

5. 120 is what fractional part of 280?

6. 10 is what fractional part of 7?

Calculating a Part of a Whole

Sample Problems:

Reduce fractions to lowest terms.

What is $^3/_4$ of 8? $^3/_4 \times {}^8/_1 = \frac{3 \times 8}{4 \times 1} = {}^{24}/_4$

$\frac{4\overline{)24}}{4\overline{)4}} = {}^6/_1 = 6$

What is $^5/_9$ of 27? $^5/_9 \times {}^{27}/_1 = {}^{135}/_9 = 15$

What is $^3/_2$ of 8? $^3/_2 \times {}^8/_1 = {}^{24}/_2 = 12$

Practice Problems:

Reduce fractions to lowest terms.

7. What is $^1/_2$ of 12?

8. What is $^2/_3$ of 15?

9. What is $^5/_6$ of 24?

10. What is $^9/_{10}$ of 150?

11. What is $^7/_{12}$ of 240?

12. What is $^5/_4$ of 12?

Proportion

Sample Problems:

$3/N = 6/8$

$3/N = 6/8$

$6 \times N = 3 \times 8$

$6 \times N = 24$

$6N = 24$

$N = 4$

$7/10 = N/5$

$7/10 = N/5$

$10 \times N = 7 \times 5$

$10 \times N = 35$

$10N = 35$

$N = 3.5$ or $3\ 1/2$

Practice Problems:

13. $3/4 = N/12$

14. $7/9 = 14/N$

15. $N/5 = 3/15$

16. $24/N = 12/13$

B. Applications of Fraction Skills

1. An average home (if uninsulated) uses about 1600 gallons of fuel oil per year for heating. With full insulation the amount of oil used is 900 gallons per year. How much oil used in the uninsulated house would be saved by insulating the home?

2. A family making $14,000 per year spends $1/20$ of this amount on energy in one form or another, such as electricity, heat, light. How much do they spend on energy in one year?

3. If a typical home with a roof area of 144 square meters receives 837×10^{10} joules of solar energy a year, how large an area would be needed to receive 628×10^{10} joules of solar energy a year?

4. Rico's family of four has a monthly net income of $750.
   a. They spent $30 for electricity. What fractional part of their income is spent for this type of energy?

   b. The energy used to heat Rico's home comes from natural gas. If they spent $^1/_{30}$ of their income for heat, how much do they spend monthly?

   c. Members of Rico's family get their muscle energy from food. $^1/_5$ of their monthly income is spent for food. How much do they spend for food energy per month?

   d. They have a $100 car payment each month and they budget $25 per month on oil and gasoline for the car. What fractional part of the monthly income is spent on the car? What fractional part of the total car expense is spent on energy fuels? (Reduce fractions to lowest terms.)

e. Rico's family also spends $20 a month on other energy such as bus fares, school lunches, etc. What fractional part of the family's income is spent for total energy in the above problems?

Lesson 2
Student Worksheet

A. Decimal Review

Addition and Subtraction of Decimal Numbers

Sample Problems:

$3.5 + 7.0 + 1.634 =$

$$\begin{array}{r} 3.5 \\ 7. \\ +\ 1.634 \\ \hline \end{array} \qquad \begin{array}{r} 3.500 \\ 7.000 \\ +\ 1.634 \\ \hline 12.134 \end{array}$$

$2.4 - .163 =$

$$\begin{array}{r} 2.4 \\ -\ .163 \\ \hline \end{array} \qquad \begin{array}{r} 2.400 \\ -\ .163 \\ \hline 2.237 \end{array}$$

Practice Problems:

1. $8.7 + 1.34 + 6$

2. $.417 + 3.2 + 7.56$

3. $1.36 - .27$

4. $.8 - .1725$

5. $\$6 + \$.34 + \$.70$

6. $\$2.30 - \$1.68$

Multiplication of Decimal Numerals

Sample Problems:

.46 x 3 =

$$\begin{array}{r} .46 \\ \times\ \ 3 \\ \hline 1.38 \end{array}$$

Counting from right to left in the answer, put in as many decimal places as there are <u>total</u> decimal places in the problem.

.13 x .007 =

$$\begin{array}{rl} .007 & (3 \text{ places}) \\ \times\ .13 & +(2 \text{ places}) \\ \hline 021 & \\ +\ 007 & \\ \hline .00091 & (5 \text{ places}) \end{array}$$

Practice Problems:

7. .37 x 5

8. 1.46 x .7

9. .724 x 6.1

10. .032 x 8.4

11. $2.48 x 19

12. $63.20 x 75

Division of Decimal Numerals

Sample Problems:

1.26 ÷ 7 =

$$
\begin{array}{r}
.18 \\
7\overline{)1.26} \\
\underline{7} \\
56 \\
\underline{56} \\
0
\end{array}
$$

12.42 ÷ .3 =

$$
\begin{array}{r}
41.4 \\
.3\overline{)12.42} \\
\underline{12} \\
4 \\
\underline{3} \\
12 \\
\underline{12} \\
0
\end{array}
$$

4.5 ÷ .15 =

$$
\begin{array}{r}
30. \\
.15\overline{)4.50} \\
\underline{4\ 5} \\
0
\end{array}
$$

Practice Problems:

Round decimals off to two places.

13. 1.35 ÷ 5

14. 62.1 ÷ 23

15. 1.215 ÷ .9

16. .2196 ÷ 6.1

17. 1.095 ÷ .73

18. 284 ÷ 7.1

19. $153.75 ÷ 25

20. $463.80 ÷ 3

Writing Numerals in Scientific Notation

Sample Problems:

1,340,000,000 = $1\,3\,4\,0\,0\,0\,0\,0\,0\,0$ (count places from right to left)
$9\ 8\ 7\ 6\ 5\ 4\ 3\ 2\ 1$

= 1.34×10^9

580,000,000,000 = 5.8×10^{11}

Practice Problems:

Write the following numbers in scientific notation.

21. 9,200,000

22. 217,000,000

23. 6,342,000,000

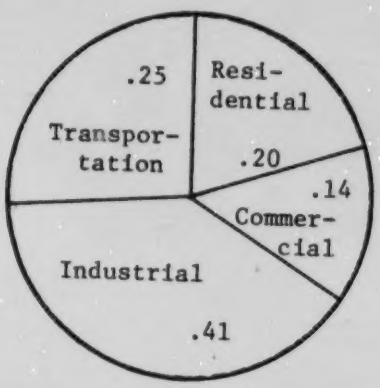
24. 7,080,000,000

Note: Scientific notation allows for easy handling of large numbers.

66

B. Applications of Fraction Skills

1. The circle graph below shows a breakdown of energy consumption by decimal part in the U.S.



Note: In all problems round to the nearest hundredth unless directed otherwise.

Total U.S. energy consumption was approximately 78.2×10^{18} (Exajoules) in 1976. Using the decimal parts given in the graph, calculate the number of Exajoules used in each category.

2. Much energy can be saved by wise usage. The following table shows potential energy savings through conservation.

PRIMARY ENERGY SAVED
[In Exajoules (joules x 10^{18})]

Economy Measure	1977
Thermostat Setback Heating (68° day/60° night)	1.55
Water Heating (120°)	.63
Air Conditioner (78°)	.13
Reduce Hot Water Use by $^1/_3$	.50
Furnace Tune-up	.63
Air Conditioner Tune-up	.96
Total	4.40

a. Write the number of joules saved by each economy measure in the chart as whole numbers. (i.e. 1.55 EJ = 1,550,000,000,000,000,000 joules)

b. Write the whole numbers in scientific notation.

3. Homeowners can save money by insulating their homes properly. The following table shows the average number of joules saved by each type of investment.

ENERGY SAVINGS FROM HOMEOWNER INVESTMENT
[In exajoules (joules x 10^{18})]

Type of Investment	1977
Insulating ceilings	.75
Weatherstripping and caulking	.33
Installing storm windows and doors	.17
Total	1.25

a. Write the number of joules saved by each homeowner investment in the chart as whole numbers.

b. Write the whole numbers in scientific notation.

4a. Find the total number of joules saved by conservation in Problem #2 and by insulation in Problem #3. Give your answer in scientific notation.

b. Using the number of exajoules of energy used for "Residential" found in Problem #1, find what decimal fraction part of the total in 4a would have been saved by the conservation measures.

5. A car travelling at 50 mph (miles per hour) averages 19.5 mpg (miles per gallon). The same car travelling at 60 mph averages 17.5 mpg. The car travels 600 miles in one day.

a. How much fuel will it use at 50 mph? At 60 mph?

b. If gasoline costs $ .65/gal, how much would it cost to travel the 600 miles at 50 mph? At 60 mph?

c. How much money would one save driving at 50 mph for 600 miles rather than at 60 mph for 600 miles?

6. Two cities, Atlas and Beeville are 500 miles apart. A trucking company is under contract to deliver goods from A to B and from B to A.

a. If a truckdriver receives $15/hr, how much would he earn at 65 mph and at 55 mph respectively for the round trip?

b. How much more money will the company have to pay the driver going the lowered speed limit?

c. At 65 mph, a truck gets 6.2 mpg and at 55 mph the same truck gets 7 mpg. What is the cost of gasoline at the two rates for the 1000 miles (round trip) if gasoline costs $ .52 per gallon?

d. What is the decrease in cost of gasoline to the company by travelling slower?

e. What total will the company probably have to pay as a result of the decreased speed limit?

f. How did the decreased speed limit affect the amount of energy used?

Lesson 3
Student Worksheet

A. Percent Review

Three Basic Types of Percent

Sample Problems:

Round answer to nearest hundred.

21% of 65 is N

$$\frac{21}{100} = \frac{N}{65}$$

$$100 \times N = 21 \times 65$$
$$100 \times N = 1365$$
$$100N = 1365$$

$$100\overline{)1365}$$

$$N = 13.65$$

or

(.21)65 = N

$$21\% = .21$$

$$\begin{array}{r} 65 \\ \times .21 \\ \hline 65 \\ 130 \\ \hline 13.65 \end{array}$$

N% of 5 is 2

$$\frac{N}{100} = \frac{2}{5}$$

$$5 \times N = 2 \times 100$$
$$5 \times N = 200$$
$$N = 40\%$$

or

$\frac{N}{100}$ (5) = 2

$$5\overline{)2.00} = 40\%$$
$$\begin{array}{r} 20 \\ \hline 0 \\ 0 \end{array}$$

35% of N is 21.7

$$\frac{35}{100} = \frac{21.7}{N}$$

$$35 \times N = 100 \times 21.7$$
$$35 \times N = 2170$$
$$N = 62$$

or

$.35N = 21.7$

$35\% = .35$

$$.35\overline{)21.70}$$
$$62.$$

Practice Problems:

1. 12% of 610 is N

2. 3% of 75 is N

3. 3 is N% of 5

4. N% of 6 is 12

5. 2% of N is 6

6. 75% of N is 216

Percent of Increase or Decrease

Sample Problems:

What is the percent of increase from 5 to 9?

(difference between 5 & 9)

$N/_{100} = {}^{4}/_{5}$

(original amount)

$5 \times N - 4 \times 100$
$5 \times N = 400$
$5N = 400$
$N = 80\%$ increase

What is the percent of decrease from 25 to 18?

(difference between 25 & 18)

$N/_{100} = {}^{7}/_{25}$

(original amount)

$25 \times N = 7 \times 100$
$25 \times N = 700$
$25N = 700$
$N = 28\%$ decrease

Practice Problems:

7. What is the percent of increase from 4 to 6?

8. What is the percent of decrease from 8 to 5?

9. What is the percent of increase from $1.25 to $1.50?

10. What is the percent of decrease from $4.00 to $2.60?

B. Applications of Percent

1. Mrs. Grey drives her car an average of 200 miles per week and uses 20 gallons of gasoline. She wants an auto that will travel the same distance but use 20% less fuel. How much fuel will she then use per week?

2. A car uses 100% more gasoline than a motorcycle. If the motorcycle travels 100 miles and uses two gallons of gasoline, how much would the car use to travel the same distance? (Hint: 2 gallons represents 100% for the motorcycle.)

3. After having a motor tune-up on her car, Mrs. Hatch's mpg (miles per gallon) increased from 15 to 18. What was the percent of the increase?

4. Miss Redlin drives her car 20 miles per day to work. In the winter, because of the ice and snow, her mpg decreases from 18 to 14. What is the percent of decrease?

5. During the year Mr. and Mrs. James' light and gas bill increased 15%. If the average cost prior to the increase was $60 per month, how much do they pay after the increase?

6. The cost of a barrel of imported crude oil in 1974 was 300% of the cost of a barrel of imported crude oil in 1973. If a barrel of imported crude oil cost $12.52 in 1974, what was the cost of a barrel of oil in 1973?
(Hint: 1973 cost = 100%)

7. Emission control standards for cars manufactured since 1970 require that carbon monoxide (CO) in exhaust fumes should not exceed 4%. A recent test of a 1974 car indicated that 150,000 cubic centimeters (cm^3) of an exhaust sample contained 7,000 cubic centimeters of CO.

   a. Determine how many cubic centimeters of CO equals 4%.

   b. Determine how many cubic centimeters the CO must be reduced to meet the 4% requirement.

8. A drop in speed from 70 mph to 50 mph increases the gasoline mileage by 20%. If your car can average 25 mpg at 70 mph, what mileage will your car get if you drive at 50 mph?

9. To conserve energy, Mr. Beamer has decided to install a solar heating system in his home. The cost, excluding taxes and finance charge, is $5000. This installation will reduce his utility bill 60%. Presently his utility bill averages $700 per year.

   a. How much money will be saved yearly after the installation?

   b. If the federal government provides a tax credit of 40% on the first $1000 and 25% on the principal balance, what is the total tax credit provided by the government on the $5000 system?

   c. How long will it take the savings in the utility bill to pay for Mr. Beamer's reduced cost of $3600? (Assume the average utility bill will remain constant.)

10. "Joule" Energy has just graduated from high school. She has a scholarship to B.T.U. in the fall, but until then she lives with her parents. She just purchased a 1976 Camaro (used). She has taken a job at the local gas station for $2.90 per hour. "Joule" works eight hours per day, five days per week. How much does she earn per week? Per month?

She has a budget plan for her earnings for the month as follows:

Entertainment	$ 90.00
Car payment	110.20
Snacks	20.00
Gasoline	50.00
Other needs	8.20

Clothing	30%
Savings	10%

a. How much did "Joule" save each month?

b. How much did she spend on clothing?

c. Which two items listed represent direct use of energy?

d. How much money was spent for energy?

e. What percent of her monthly earnings did she spend for energy?

f. "Joule" spent $50 for gasoline. At 69.9¢ per gallon how many gallons of gasoline did she purchase?

g. If "Joule's" car can travel 22 miles on one gallon of gasoline, how many miles did she travel on the total amount of gasoline purchased?

11. The President's Seven Energy Goals for 1985 are stated in his speech to Congress on April 12, 1977 are as follows:

I. Reduce the annual growth rate in our energy consumption to less than 2%.

II. Reduce gasoline consumption by 10%.

III. Cut imports of foreign oil to less than 6 million barrels a day, less than half the amount that we will be importing if we do not conserve.

IV. Establish a strategic petroleum reserve supply of at least 1 billion barrels, which will meet our needs for about 10 months.

V. Increase our coal production by more than two-thirds, to cover one billion tons a year.

VI. Insulate 90% of American homes and all new buildings.

VII. Use solar energy in more than $2\frac{1}{2}$ million American homes.

a. In 1975, energy consumption in the United States was $.74 \times 10^{18}$ joules. If consumption had grown by only 2% what would 1976 consumption have been?

b. 1976 consumption was $.78 \times 10^{18}$ joules. What was the real growth rate?

c. If the present gasoline consumption is about 100 billion gallons a year, how many gallons of gasoline will be consumed after the 10% reduction?

d. The forecasts in the National Energy Plan show the amount of imported petroleum could be as much as 11 million barrels per day by 1980. The President would like to limit the amount of imported oil to less than 6 million barrels per day. If we are able to decrease our imports from 11 million to 6 million barrels per day, what would be the percent of decrease in imported oil?

e. If a billion barrels of oil is enough reserved oil to last the U.S. for 10 months, how much oil do we need per month? Per day?

f. Despite the need to encourage production of domestic forms of energy, the supply of coal dropped from 595 million tons in 1972 to 590 million tons in 1973. President Carter would like to have the industry increase their production to 1 billion tons. What percent of increase from the 1973 level would this require?

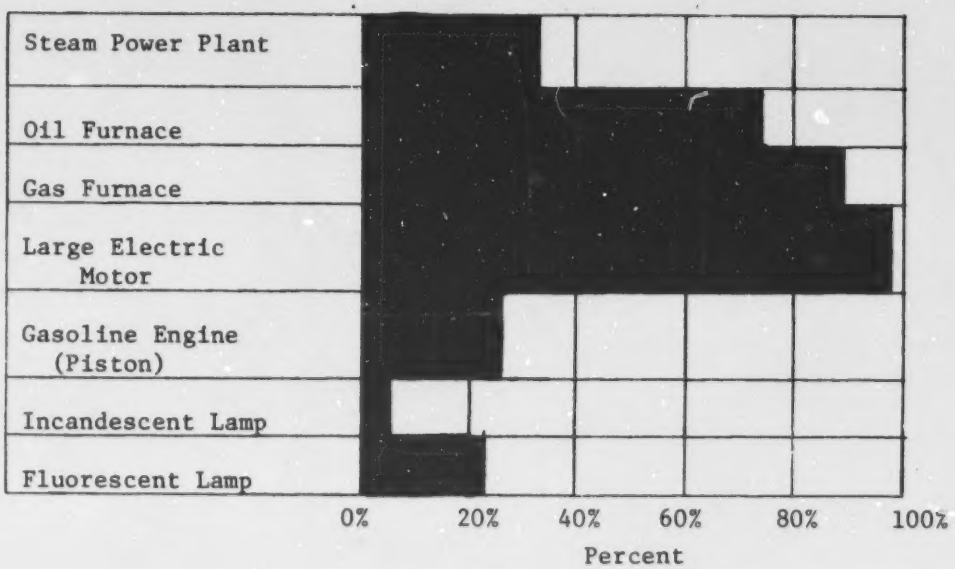
g. If there are approximately 70 million American homes, how many must be insulated by 1985 if we are able to insulate 90% by that time?

h. In 1976 there were 500 homes heated by solar energy. President Carter proposes that 2.5 million homes be heated by solar energy by 1985. What is the increase in percentage of homes heated by solar energy between 1976 and 1985?

Lesson 4
Student Worksheet

1. The "efficiency" of an energy source is measured by a comparison of the output (in energy, time, money, etc.) with the input of the same quantity. The following bar graph shows:

PERCENTAGE OF ENERGY USED WHICH IS CONVERTED TO USEFUL WORK



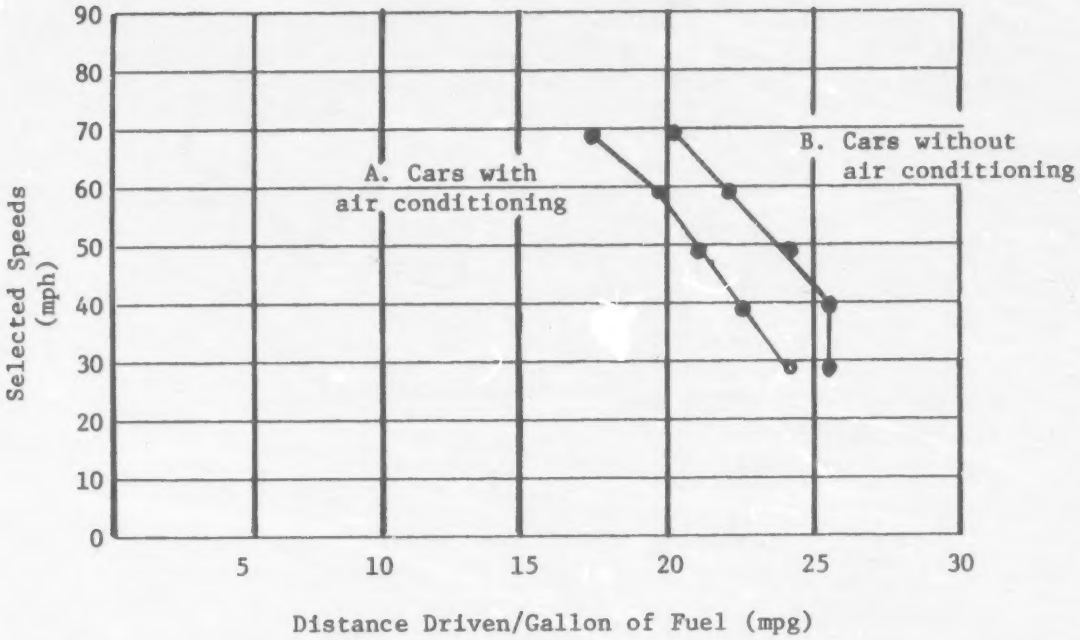
a. What percent of energy is converted to useful work for each plant, furnace, etc.?

b. Which of the above energy sources is most efficient?

c. Least efficient?

d. Discuss the efficiency of each energy source. What causes them to be less efficient?

2. EFFECT OF SPEED ON FUEL CONSUMPTION RATES



a. At what speeds will Cars A and B travel farther on one gallon of fuel?

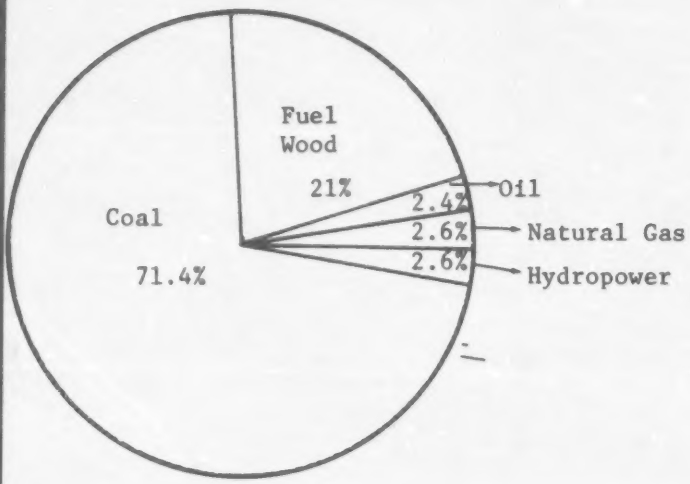
b. What will be the rate of fuel consumption when the cars travel at their minimum fuel consumption rate according to the graph? (Hint: 1 gal per ___ mi[at 30 mi/hr])

c. At 55 mph what is the fuel consumption rate for each car?

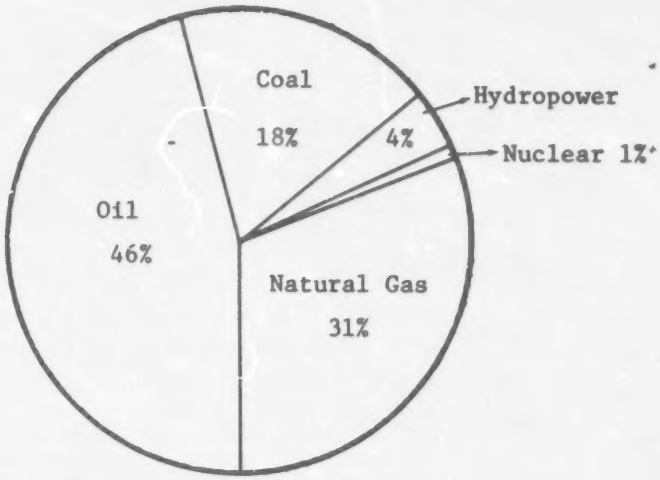
3. Study the two circle graphs below and answer the questions which follow.

SOURCES OF ENERGY

1900



1973



a. In 1900 which source of fuel was used most?

b. What source of fuel was used in 1900 but not in 1973?

c. What source of fuel was used in 1973 but not in 1900?

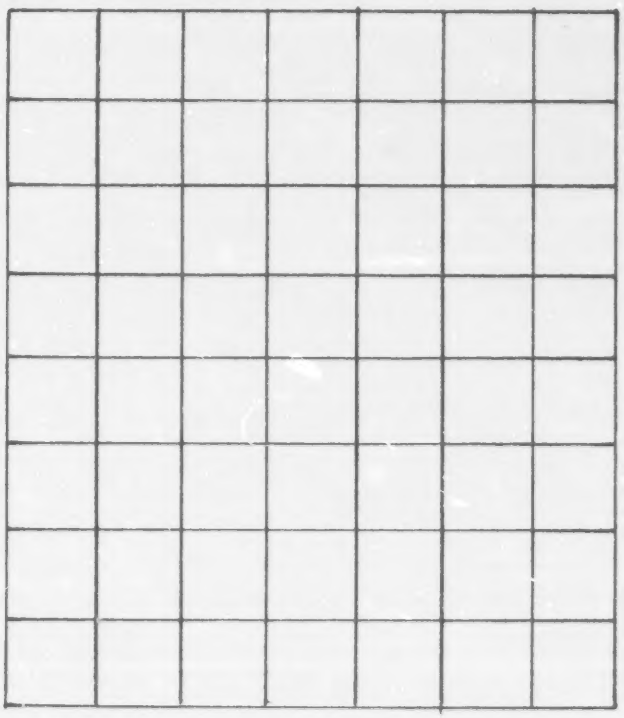
d. In your opinion, why was more natural gas used in 1973 than in 1900?

B. Constructing Graphs

4. The American Energy Crisis occurred in 1973 and 1974. The Organization of Petroleum Exporting Countries (OPEC) forced oil prices upward to gain control of the market. They then placed an oil embargo on the oil imported by the United States. The result was a tremendous increase in oil prices. In 1971 the price began to rise.

Year	Cost
1970	$ 1.80
1971	2.18
1972	2.48
1973	5.18
1974	11.25
1975	12.38
1976	13.00
1977	13.50

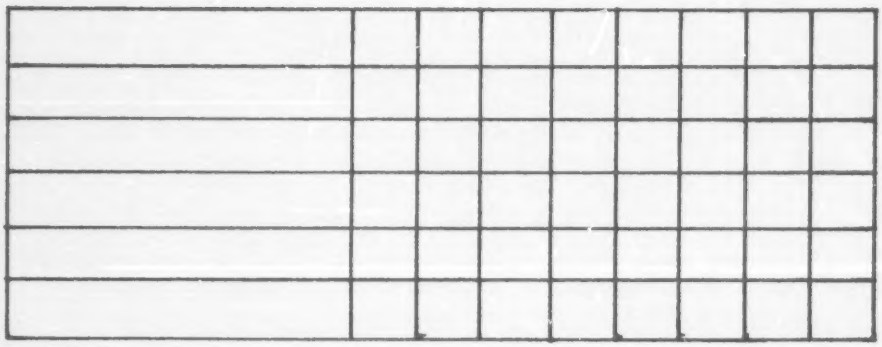
Make a line graph (in the space below) to show the trend in oil prices from 1970 to 1977.



5. Listed below are the percents of total energy used by the most common appliances in the home/year.

Electric range	15%
T.V.	9%
Clothes dryer	5%
Water heater	38%
Room air conditioner	8%
Refrigerator	20%

a. In the space below construct a bar graph of the information given above.



b. Which appliance(s) uses the most energy?

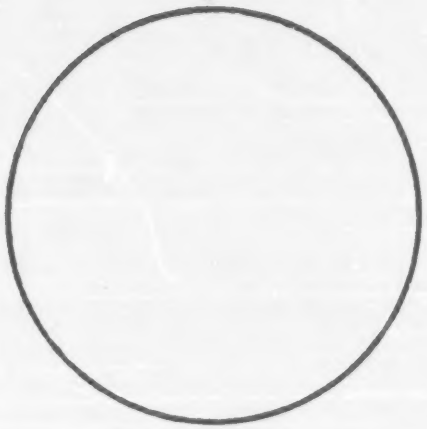
c. Which appliance(s) uses the least?

d. Can you think of ways to conserve the energy used by these appliances?

6. a. Make a circle graph in the space below to show the United States' use of Energy Resources in 1974.

Energy Source	Percent of Energy
Petroleum	46%
Natural gas	30%
Coal	18%
Nuclear	2%
Hydroelectric	4%

Note: Estimate the size of the sections of the circle.



b. What percent of the above energy comes from fossil fuels?

7. It was estimated that the total cost for air pollution in 1968 was $16.2 billion. A partial breakdown of these costs include:

$6.1	billion for health effects
$4.8	billion for effects on materials (rust, corrosion, damage to fabrics, cost of protective coating, etc.)
$5.2	billion for damage to residential property (including reduction in value)
$0.12	billion for damage to commercial crops

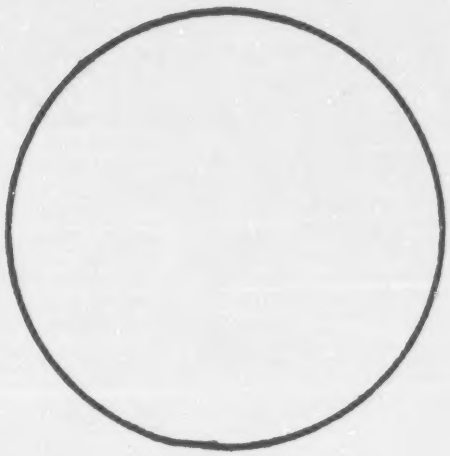
Round all answers to tenths.

a. Determine the percentage of the total cost that each category represents.

b. Determine the number of degrees of a circle that each percentage (in problem "a" above) represents. (There are 360° in a circle.) Round off to nearest whole degree.

$$\%/_{100} = N°/_{360°}$$

c. Show this information in the form of a circle graph.



d. Find the total of the degrees shown in the circle graph. Why is the total not 360°?

e. Assume the population of the United States was 2.025×10^8 in 1968. What was the per capita cost of air pollution (to the nearest cent)?

Facts About Energy

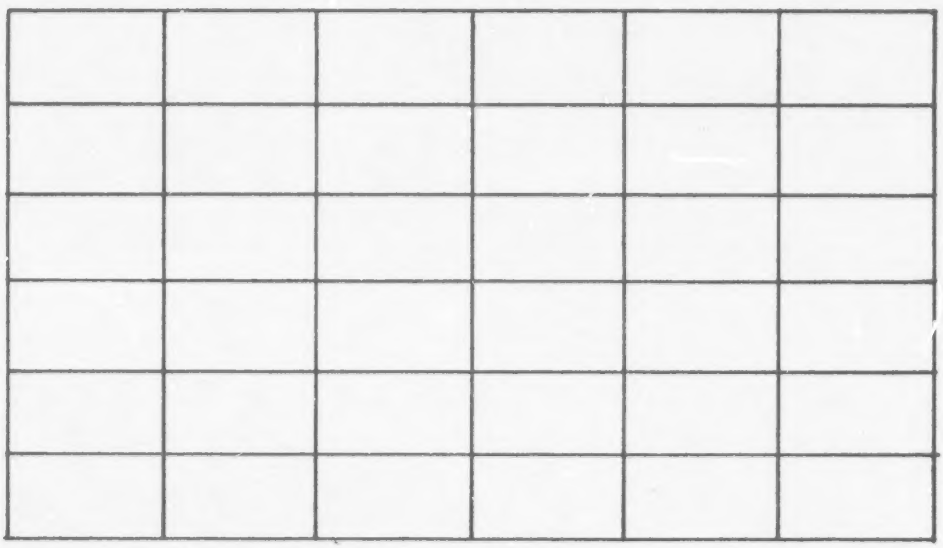
Energy received by a field (approximately 1 acre or .04 hectare) from the sun	= 66,880 megajoules
1 megajoule	= 1 million joules
Power of a human at rest	= .06 x 10^6 joules
Human walk for 5 seconds	= 1000 joules
200 calorie candy bar	= 836800 joules
Energy released by burning 1 kg of wood	= 11.5 million joules
Energy released by burning 1 kg of coal	= 30.4 million joules
Energy released by burning 1 kg of gasoline	= 43.8 million joules
Energy needed to melt 1 kg of ice	= 331372.8 joules
Energy needed to manufacture one automobile	= 21756.8 x 10^6 joules
Energy needed to evaporate 1 kg of water	= 2255176 joules
4184 joules	= 1 Calorie
Acceleration of a free-falling object here on Earth	= 9.8 meters/sec^2
Number of joules needed to light one 1-watt bulb for 40 hours	= 9623.2 joules
Work	= force x distance
Energy	= the ability to do work
Newton	= a unit to force
Mass (kg) x 9.8 Newtons/sec^2	= weight (Newtons)
1 Newton-Meter (force x distance)	= 1 joule (work or energy)

Student Activity 1

The following problems deal with population and energy consumption in the United States from 1920 to 1970.

a) Research for total population figures of the United States from 1920 to 1970. List the statistics for each decade.

b) Make a bar graph to show the data.



c) Do research to find the per capita energy consumption for each decade.

d) Compute the percent of increase in energy use per capita from 1920 to 1970.

e) Considering the trend from 1920 to 1970 in part c, project the energy consumption per capita from 1970 to 1980.

f) Considering the trends in the population statistics from 1920 to 1970, what do you estimate the population to be by 1980?

g) What is the total number of joules of energy needed to supply the 1980 population from 1970 to 1980?

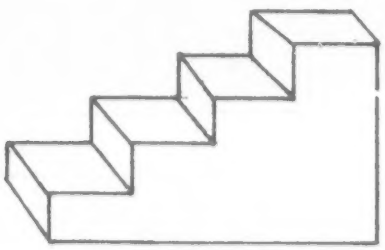
Student Activity 2

Weight lifting and running are two activities that athletes participate in when training. Use information on page 95.

a. If an athlete lifts a 980 Newton weight through a distance of 2.5 meters, 10 times, how much work in joules did s/he do?

b. Did the athlete (in "a") use enough energy to light a 1-watt bulb? If not, how much more energy would s/he need to use? If so, for how many hours would the bulbs stay lit?

c. If the athlete who weighs 980 Newtons runs up stairway "A" five times, does s/he do as much work as s/he did when lifting the weight?



Stairway A

Student Activity 3

The following activity is related to the automobile. The object is to find the energy, in the form of fuel, needed to operate the vehicle, and then, by conversion, to calculate the number of batteries needed to operate the vehicle. (Note: If you do not drive a car, you will need the cooperation of a person who will keep a record for you.)

Procedure:

I. a. Fill in the gas tank of the automobile at the beginning of the week. Record the odometer reading at this time.

b. Fill the tank seven days later to determine the gallons of gasoline used. (If additional gas was purchased during the week, be sure to add the number of gallons.)

c. Record the odometer reading at the end of the week.

d. Subtract the odometer readings to determine the number of miles travelled.

e. Compute the number of miles per gallon for the car.

f. Compute the average number of miles travelled per day.

g. Compute the average number of gallons used per day.

Date	Odometer	Gallons

h. The energy contained in one gallon of gasoline is approximately equivalent to the energy contained in 50 batteries. However, the efficiency of a battery is about 90%, while the efficiency of a gasoline powered engine is only about 20%. How many times as efficient is the battery than the gasoline powered motor? _____ Therefore, the number of batteries needed to provide the energy of one gallon of gasoline would be divided by this efficiency number, $4\ ^{1}/_{2}$. N = _____. The energy of how many batteries would be needed for the miles travelled in one day?

i. One battery measures about $^1/_2$' (15 cm) by $^3/_4$' (22.5 cm) by 1' (30 cm). What is the volume of the battery? (Hint: v = w x h x l) How many cubic meters does the v =?

j. How many cubic feet of space would be needed for the batteries for energy for one day?

k. Build a cardboard model of this volume (in a practical shape) to show the space needed for the batteries to operate the car for one day. (This could be a scale model and could include the design of an automobile of the future.)

II. Problems Relating to the Metric System:

a. Convert the numbers of miles travelled per day to kilometers.

b. Convert the number of gallons of gasoline to liters.

c. Compute the number of kilometers per liter.

PRE/POST TEST

I. Fractions

Solve the following problems. (Give answers in simplest form.)

1. 6 is what fractional part of 15?

2. 2 is what fractional part of 100?

3. 18 is what fractional part of 12?

4. What is $^{1}/_{5}$ of 35?

5. What is $^{4}/_{7}$ of 28?

6. What is $^{7}/_{10}$ of 40?

7. Solve for N: $N/9 = {}^{20}/_{36}$

8. Solve for N: ${}^{6}/_{8} = {}^{30}/N$

9. Hydrocarbons make 15% of the pollution in the air caused by the automobile. What fractional part of the total pollution caused by the auto is this?

10. The percent of nitrogen oxides in the pollutants caused by the automobile is ${}^{2}/_{3}$ of the percent of the pollution caused by hydrocarbons. What percent of the total is caused by nitrogen oxide? (Refer to the previous problem.)

II. Decimals Solve the following problems.

1. 1.2 + .7 + 13.4

2. .75 - .346

3. 5 x 1.4

4. 1.2 x .06

5. 3.25 ÷ 5

6. 2.25 ÷ .15

7. Write in scientific notation: 500,000

8. Write in scientific notation: 1,340,000,000

9. In 1969, accidental spills, such as collisions, oil blow-outs, etc., accounted for 10% of the total oil pollution in the ocean. If 200,000 tons were contributed by these accidents, what was the total number of tons of oil pollution in the ocean?

10. The total energy potential from solid waste (garbage), if converted to oil, could provide 20% of our current oil consumption. If our current oil consumption is 5.5 billion barrels per year, how much oil could be provided by garbage?

III. Percents Solve the following problems.

1. 15% of 325 = N

2. 130% of 20 = N

3. 5 is N% of 15

4. 30 is N% of 25

5. 45% of N = 90

6. 25% of N = 400

7. What is the percent of increase from 6 to 10?

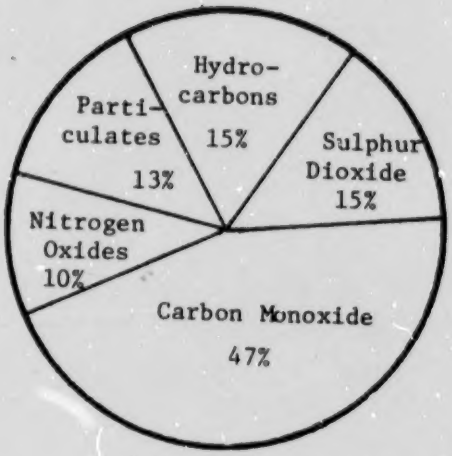
8. What is the percent of decrease from 15 to 10?

9. In 1960, the cost of gasoline was $ .30/gal and in 1977 the cost was $ .70/gal. What was the percent of increase?

10. Insulation of a home decreases the heating bill approximately 20%. How much was Mr. Page's bill prior to insulating his home if his present bill is $300.00 per year?

IV. Graphing

It has been determined that the total cost for air pollution in 1968 was $16.2 billion, or approximately $80 for each person in the U.S. Information pertaining to air pollution is expressed in the form of a graph.



1. What fractional part of the circle is represented by hydrocarbons?

2. How many degrees of the circle are represented by carbon monoxide?

REFERENCES:

[1] Energy-Environment Source Book, John M. Fowler National Science Teachers Association, Washington, D.C., 1975.

[2] Energy in Focus, Federal Energy Administration, Washington, D.C., 1977.

[3] Environmental Education Curriculum, Infusion United, New York State Education Department, page 75.

[4] The National Energy Plan, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 1977.

[5] Business Week, February 2, 1974.

[6] Energy Conservation in the Home, United States Department of Energy, October 1977.

[7] Statistical Abstracts of the United States, Department of Commerce, Washington, D.C., 1976, page 549.

* U.S. GOVERNMENT PRINTING OFFICE 1978—281-128/699